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PILTER'S HAY PRESS.

THE carriage of hay to great distances has proved so expensive in past years, because of the bulkiness of the material, that the consumption of the product has necessarily been confined to within a short distance of the place of its preparation. One of the most important branches of commerce has thus of necessity been curtailed, notwithstanding the multiplication of railways, these not sufficing to give an outlet to the production.

In order to remedy so unfavorable a state of things, presses were introduced for reducing the bulk of the material and diminishing the cost of carriage proportionally to the density obtained with the apparatus. Despite such advantages the use of hay presses did not extend to private exploitations, and was scarcely applied except in the compression of hay designed to be loaded on ships. This was due to the *modus operandi*, which presented the drawback of spoiling the material. In fact, the first presses formed cubical bales in which the fibers of the hay were completely broken up and reduced to powder at the moment of use. Besides, the mean density did not exceed 150 to 180 kilometers to the cubic meter: the handling of the bales was difficult; and the mode of tying did not sufficiently protect the angles of these.

In order to obviate such difficulties, Mr. Th. Pilter invented a few years ago a new press, which appeared for the first time at the Exhibition of 1878, and which has lately undergone all the improvements that practice has indicated as necessary.

Since its introduction, there has been obtained with this apparatus: (1) a density in the compressed hay varying from 200 to 400 kilometers to the cubic meter; (2) a methodical classing of the fibers in a lengthwise direction, and a mode of winding them without breakage according to the cylindrical form of the bale; and the certainty that the new arrangement will not allow of hay of inferior quality being introduced. Thanks to the cylindrical form of the bales, they can be more easily handled, as they are capable of being rolled over the ground and loaded upon cars or wagons by means of an inclined plane.

The press is shown in elevation, rear view, longitudinal section, front view, and perspective in Figs. 1 to 5. The perspective view shows the hopper, which is suppressed in the other figures, and which consists of two sides and a bottom of wood, in which there are longitudinal slits that give passage to species of movable rakes that are provided with teeth, and are articulated at their posterior extremities with winches. These latter are keyed upon a transverse shaft which is set in rotation by means of a cone wheel whose pinion is fixed upon the shaft, *a'*. The object of this ingenious mechanism is to give the rakes a simultaneous backward and forward motion, and one of rise and fall, so as to bring about a forward motion of the hay introduced into the hopper.

The hay is thus placed in contact with two cones, C, which are opposed by their apices, and are traversed by axes of the same direction. It is afterward carried along by the revolving cones, which compress it in the first place against the disk, P, at the beginning of its travel.

Each of the cones, C, carries near its base a series of teeth that correspond to an internal gearing that is cast in a piece with the crown wheel, D. The latter is provided internally with teeth that gear with a pinion, D, which communicates to it its rotary motion. The crown wheel, D, in its motion, revolves over three rollers that are provided with flanges to prevent lateral displacements. The shells in which the rollers revolve, as well as the axles of the interior cones, are connected with the jacket which forms the frame of the machine, and which at the same time protects the internal gearing from contact with the hay, and which likewise serves as a support for the hopper, and as a fixed part to which is connected the fore carriage.

The disk, P, whose surface in contact with the hay is slightly conical and carries four ribs, is capable of sliding horizontally on the guides, *f*, which are properly cross stayed in front and affixed behind to the crown wheel, D. It revolves with the latter in such a way that the hay, fed continuously by the cones, C, winds around spirally without any breakage or torsion of the fibers.

The origin of the driving mechanism is the pulley, A, mounted directly upon the shaft, *b*, which receives, in addition the loose pinions, D', *i*, and *e*, that are capable of being carried along by the shaft, *b*, when they engage with each other, the first with the gearing mechanism, M, and the two others with the sleeve, N.

The pinion, *i*, engages with the wheel, *i'*, and the second, *e*, which controls the return of the disk, P, actuates the pinion, *e'*, through an intermediate pinion which reverses the direction of the motion. These two gearings, *i'* and *e'*, are keyed upon the cast iron bush, F, which is threaded internally to receive the screw, V. This latter is traversed longitudinally by the square rod, E, which is connected with the disk, P. This rod, E, slides by friction through two jaws, *n*, that embrace the neck of the screw, V, and that are tightened up as may be desired by a screw traversing the ring, *n'*. This arrangement constitutes a brake which regulates the stress exerted in the hay during compression.

The apparatus, in forming a bale of hay, works as follows: The belt having been put upon the pulley, A, the workman acts upon the lever, *l* (Fig. 1), in order to throw into gear the sleeve, N, and the pinion, *i*. He maneuvers in the same way the lever, *l'*, in order to engage the sleeve, M, with the pinion, D'. This then causes a revolution of the crown wheel, D, and brings about a rotation of the cones, C, around their axes. A certain compression of the material effects a recoil of the disk. During this first period of the work, the screw, V, revolving with the bush, F, does not move longitudinally. When the disk has recoiled sufficiently, so that the bale that is being formed possesses the desired length, the workman disengages the sleeve, M, from the crown wheel, D, and the cones cease to revolve. At the same time, the motion of the rake is interrupted automatically in the following way:

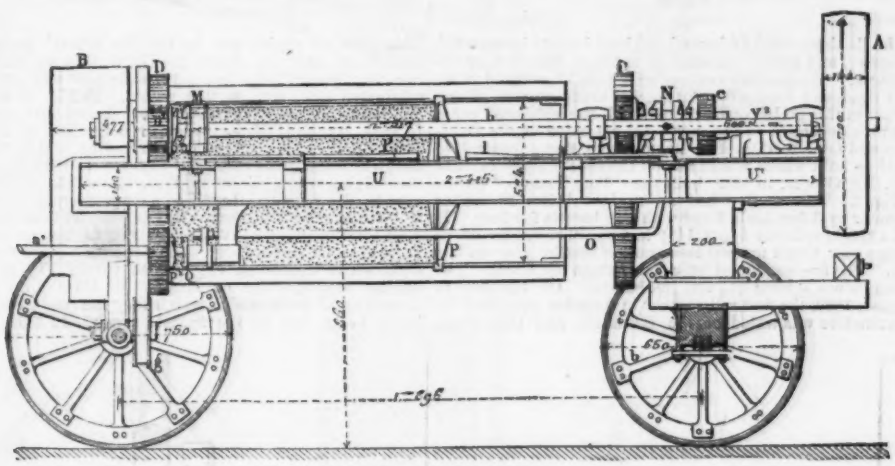


FIG. 1.—ELEVATION.

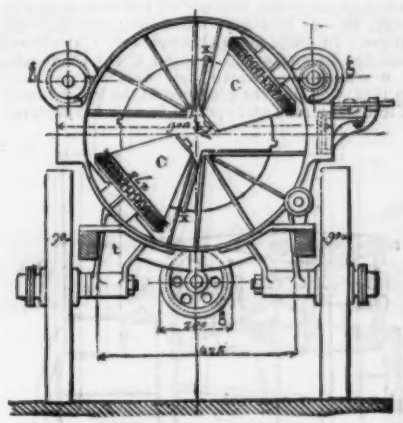


FIG. 2.—REAR VIEW.

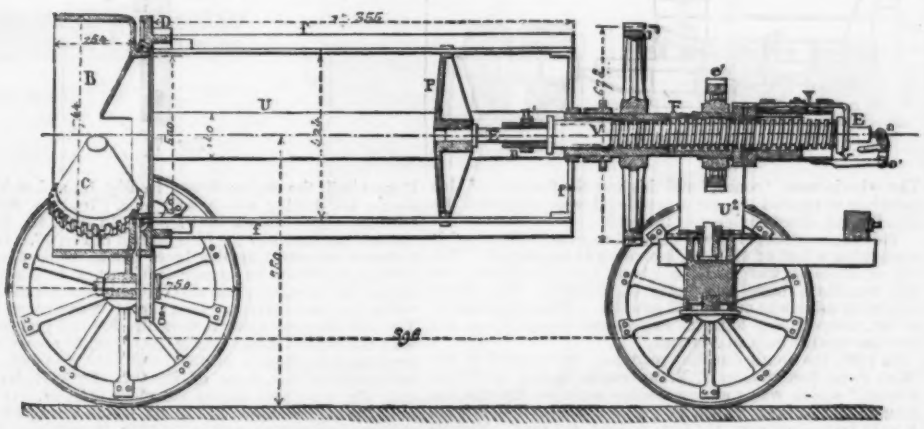


FIG. 3.—LONGITUDINAL SECTION.

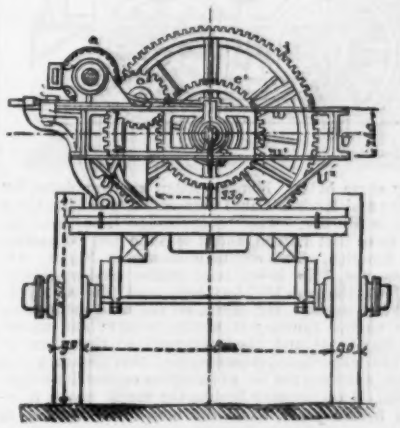


FIG. 4.—FRONT VIEW.

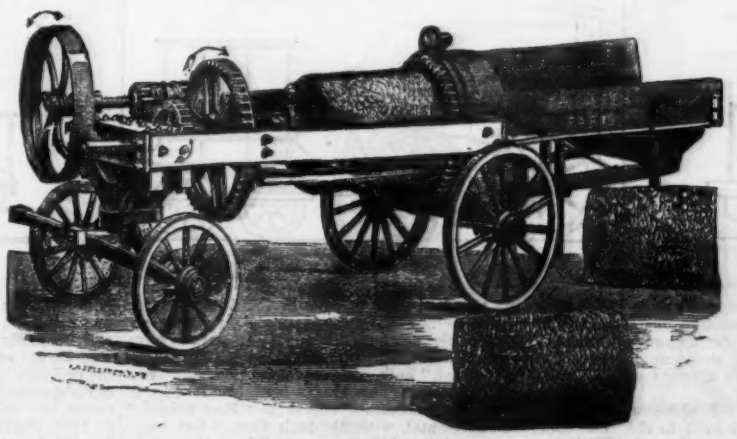


FIG. 5.—GENERAL VIEW.

IMPROVED FRENCH HAY PRESS.

The extremity of the rod, E, strikes against a stop, *o*, which is articulated around the point, *o'*. This leverage produces a traction on the rod, O, which ungears the sleeve, Q, and the pinion, *p*, then revolves loosely upon its shaft, *a'*.

The disk, P, being rendered immovable, and the socket, F, continuing its revolution, the screw, V, moves forward and thrusts the disk against the bundle of hay and produces the definite pressure. During this time, the workmen pass two wire binders, through two small groves, arranged according to two diameters, at right angles on the surface of the disk, P, as well as through analogous grooves formed in the interior of the cylinder, B.

The binding, once effected, the sleeve, N, is drawn back from the pinion, *i*, and put in gear with the pinion, *o*, thus changing the direction of rotation of the socket, F, causing the disk to recoil, and thus freeing the bale of hay, which then drops on the ground.

When the disk, P, has reached the end of its travel, it might happen that the workman, having his attention diverted, should neglect to ungear the pinion, N; and in this case a breakage would prove inevitable. In order to prevent this, the gearing is rendered automatic in a very simple manner. The extremity of the screw, V, carries a collar, *v*, which acts upon a forked rod, *y*, that is connected by a lever with the bar, *y'*, thus bringing about a displacement of the sleeve, N.

This press is capable of producing regularly, with the aid of two men and three good horses, 6 bales of from 90 to 100 kilogrammes per hour; and, with four horses, 7 to 8 bales. With a steam engine, a regular production may be obtained of from 10 to 12 bales, each weighing from 100 to 120 kilogrammes, and, being 0·65 meter in diameter by 1·20 meter in length.

The apparatus may likewise be used for compressing any fibrous material, such as cotton, hemp, alfa, straw, etc., and is thus capable of rendering service in various industries.—*Revue Industrielle.*

[NATIONAL CAR BUILDER.]

EARLY AMERICAN LOCOMOTIVES AND RAILROADS.

THE first railroad built in America appears to have been at Quincy, Mass., in 1826. It was three miles long. In 1827 another was built for the use of the coal mines at Mauch Chunk, Pa. It was nine miles long, and was operated by mules. In 1828, the Baltimore and Ohio, South Carolina and the Delaware and Hudson Canal Companies each built a road, all of which were operated by horse power. In 1812, Col. Stevens proposed to the legislature of New York to build a road and operate it with locomotives,

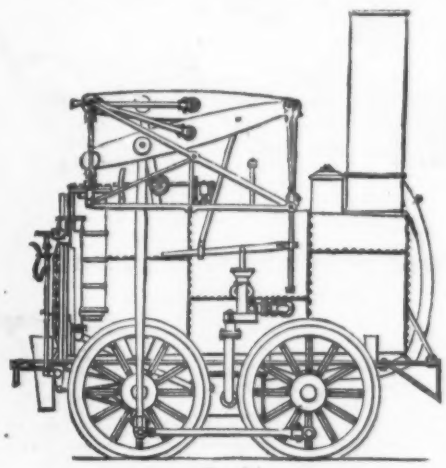


Fig. 1.

but nothing came of it. Horatio Allen was appointed by the Delaware and Hudson Canal Company to purchase three locomotives in Europe. The "Stourbridge Lion" was the first of the three that arrived, and it was the first locomotive brought to America. This engine is shown in Fig. 1. On the 8th of August, 1829, it was tried on the road at Honesdale, Pa. Its boiler was 16½ feet long, and the two cylinders were 3 feet stroke. Mr. Allen, on the date mentioned, started the engine, running it around a curve and up the road about two miles and then returned to the place of starting. This experiment demonstrated that the track was not sufficiently substantial for so heavy an engine, its weight being 7 tons. It was housed beside the track, where it remained for fifteen years, when the boiler was removed to

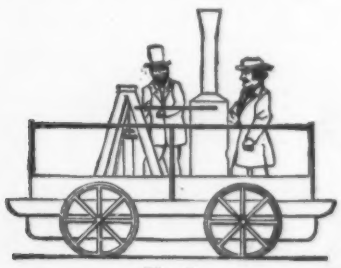


Fig. 2.

Carbondale and used for stationary purposes and the remainder sold for old iron. Thus the first locomotive was a failure. In September, 1829, one of Geo. Stephenson's engines arrived in New York, and was jacked up clear of the rails and run. The following is Mr. Allen's account of his trip on the "Stourbridge Lion."

"The circumstances which led to my being left alone on the engine were these: The road had been built in the summer, the structure was of hemlock timber, and the rails of large dimensions notched on caps placed far apart. The timber had cracked and warped from exposure to the sun. After about 500 feet of straight line, the road crossed the Lackawaxen Creek on a trestle-work about 30 feet high and with a curve of 360 feet radius. The impression was very general that the iron monster would either break down the road, or that it would leave the track at the curve and plunge into the creek. My reply to such apprehensions was, that it was too late to consider the probabilities of such occurrences; that there was no other course but to have the trial made of the strange animal which had been brought here at such great expense, but that it was not necessary that more than one should be involved in its fate; that I could take the first ride alone, and that the time would come when I should look back to this incident with great interest. As I placed my hand on the throttle I was undecided whether I should move slowly or with a fair degree of speed, but believing that the road would prove safe, and preferring, if we did go down, to do so handsomely and without any evidence of timidity, I started with considerable velocity, passed the curve over the creek safely, and was soon out of hearing of the cheers of the large assemblage present. At the end of two or three miles I reversed the valve and returned without accident to the place of starting, having thus made the first railroad trip by locomotive on the Western hemisphere."

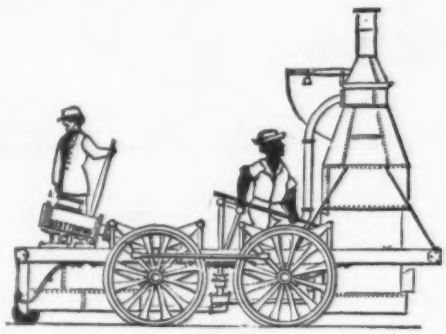


Fig. 3.

The Baltimore and Ohio road had been built to be operated by horses, and to save expense in cuttings, curves were introduced. The English engines were thus ill adapted, with their rigid and long wheel bases, for short curves. Peter Cooper at this period owned some land, the enhanced value of which depended on the successful operation of the Baltimore and Ohio road, and to demonstrate that a locomotive could be built which would run on the short curves of that road, Mr. Cooper, in 1829, built the "Tom Thumb," shown in Fig. 2. This engine had an upright boiler 20 inches diameter by 5 feet high, fitted with gun barrels for flues. It had a single cylinder 3¼ × 14¼ inches. The engine drove a large gear which meshed into another smaller gear on the axle. The fire was urged by a fan driven by a belt. The driving-wheels were 2½ feet in diameter. On the 28th of August, 1830, the first railroad car in America propelled by a locomotive was tested on the Baltimore and Ohio road.

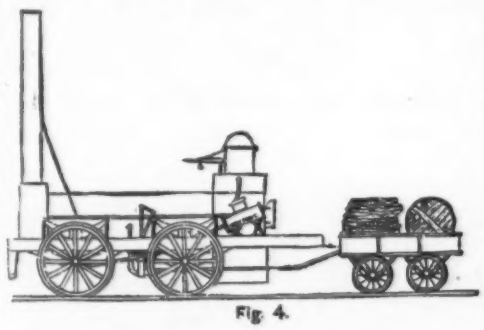


Fig. 4.

The wheels were "coned," and this was the first use of this principle as applied to car wheels, and was suggested by Mr. Knight, chief engineer of the road.

This engine (Cooper's) was coupled to a car in front of it containing a load of 4½ tons, including 24 passengers. The trip of 13 miles was made in 1 hour and 15 minutes, the best time for a single mile being 3¼ minutes. The return trip of 13 miles was made in 57 minutes. While this engine of Mr. Cooper's was built for experiment solely, it was the first locomotive built in America.

In 1830, the South Carolina road had constructed at the West Point Foundry, in N. Y., an engine called the "Best Friend," which was the first engine built in America for actual service. It is shown in Fig. 3. The cylinders were 6 × 16 inches; drivers, 4½ feet; weight, 4½ tons. Nichols

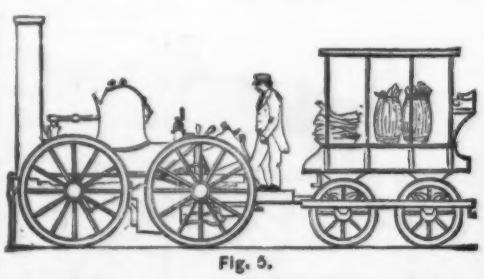


Fig. 5.

W. Darrell ran this engine on the South Carolina road for some time, and remained in this company's service as engineer until near his death in 1869. He appears to have been the first regular locomotive engineer in America. In 1831 the "West Point," built at West Point Foundry, was started on the same road. This engine is shown in Fig. 4, and had same size cylinder and wheels as the "Best Friend." The boiler was horizontal, with 2½ inch flues, 6 feet long. With five cars containing 117 passengers, this engine made 2½ miles in 8 minutes.

In 1831 the West Point Foundry built a third locomotive called the "De Witt Clinton," for the Mohawk and Hudson Railroad, of N. Y. It is shown in Fig. 5. In 1831, John B. Jervis, Chief Engineer of the Mohawk and Hudson road, designed an engine with the truck under the cylinders. This engine was built at the West Point Foundry, but was the first engine in the world on which a truck, or "bogie," was used. Mr. Jervis sent drawings of this device to England, from which Stephenson built the "Davy Crockett" for the Saratoga Railroad Co.

Mathew Baldwin, a jeweler and silversmith, of Philadelphia, built in 1831 a miniature locomotive for the Philadelphia Museum. In 1832, he built for the Philadelphia, Germantown, and Norristown road, an engine called "Old Ironsides," shown in Fig. 6. Its weight was 5 tons, driving wheels 54 inches in diameter, cylinders 9½ × 18 inches. Wood was used for spokes and rim of the wheels, as well as for the frame of the engine. In 1834, Mr. Baldwin patented the half crank, shown in Fig. 7, which was in use for some time afterward. It was a much cheaper crank than the ordinary form. Mr. Baldwin's second engine was built in 1834, for the Charleston and Hamburg road. The drivers were cast from bell metal. As they soon wore out, nothing further in this line of wheel was attempted. The cylinders were 10 × 16 inches. This engine is shown in Fig. 8.

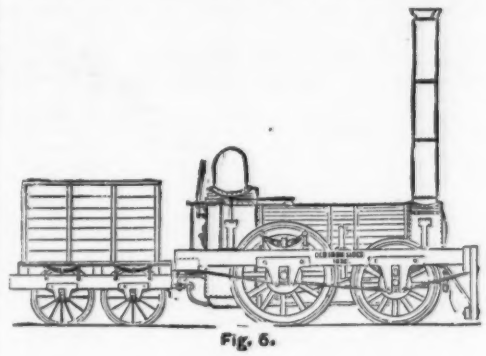


Fig. 6.

This form of engine was in use for several years. The drivers and axle are shown in Fig. 9. To Mr. Baldwin is due the "ground joint" so universally used now, and which originated with him at this period. In Fig. 10 is shown Mr. Baldwin's combination of pump barrel and guide-bar. In 1834, Mr. E. L. Miller patented a method of throwing part of the tender's weight on the engine, and in 1839, Mr. Baldwin bought this patent for $9,000. In 1835, he patented the driving wheel shown in Figs. 11 and 12. In the same year he also patented the use of a copper ferrule on the outside of the end of the flue to form a joint with the flue sheet. This form of joint is extensively used at the present day. In 1846 and afterward, Mr. Baldwin built a large number of eight-wheel connected engines, shown in Fig. 13. They became very popular on account of their great hauling capacity and the ease with which they ran round curves, this latter being due to the flexible truck. In 1837, Thomas

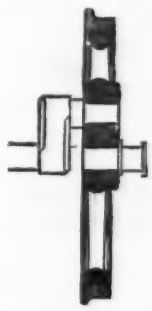


FIG. 7.

Rogers built the engine shown in Fig. 14, and in Fig. 15 is shown his driving wheels and axle. In 1838, Mr. Rogers built the engine shown in Fig. 16. In 1842, Mr. Baldwin's engines had assumed the form shown in Fig. 17. In Fig. 18 is shown his patent flexible beam truck, which allowed the forward drivers to be formed into a truck to accommodate themselves to curves, and also of being connected by a side rod to the back drivers. This engine became very popular. The 1844 Rogers engine is shown in Fig. 19, and in 1845 he built the engine shown in Fig. 20. Fig. 21 shows the valve gear used by Rogers in 1845 and 1846. In 1847, his gear had assumed the form of Fig. 22. In 1848, Mr. Rogers built the ten-wheel engine shown in Fig. 23. In 1850, he built the engine shown in Fig. 24, which was fitted with the shifting link motion, and in 1854 Mr. Rogers used the valve

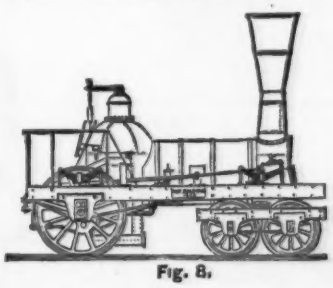


Fig. 8.

gear shown in Fig. 25. To him is also due the credit of first using the expansion plate.

In 1857, Mr. Baldwin built the rack rail engine, shown in Fig. 26, for operating an inclined plane. On a level track the ordinary cylinders were used, while on the incline the upright cylinder drove the gear meshing into the rack between the rails, thus assisting the engine very materially. In 1848, Baldwin built the fast passenger engine shown in Fig. 27, for the Vermont Central road. The contract was for a speed of 60 miles per hour with train. The drivers were 6½ feet diameter, cylinders 17¼ by 20 inches. It is stated that this engine could be started from a state of rest and run a mile in 43 seconds. In 1858, Baldwin used the valve gear shown in Fig. 28.

FRANK C. SMITH.

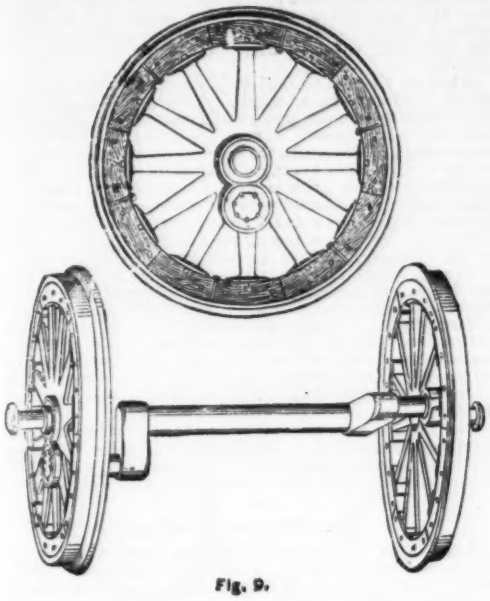


Fig. 9.

Fig. 15.

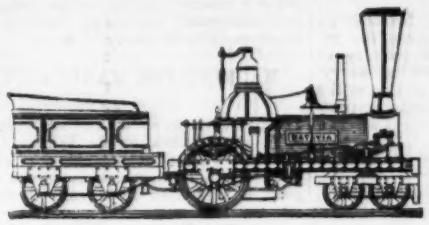


Fig. 16.

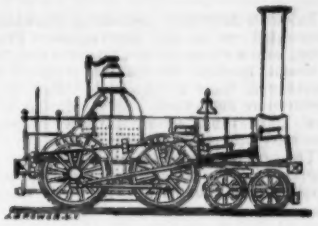


Fig. 20.

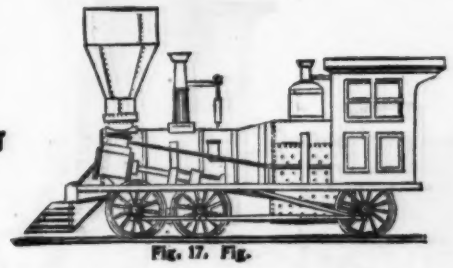


Fig. 17. Fig.

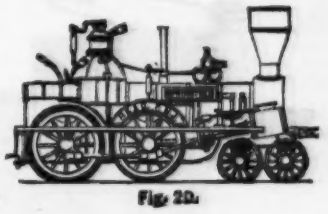


Fig. 20.

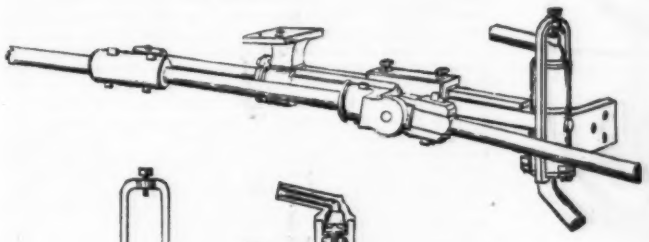


Fig. 10.

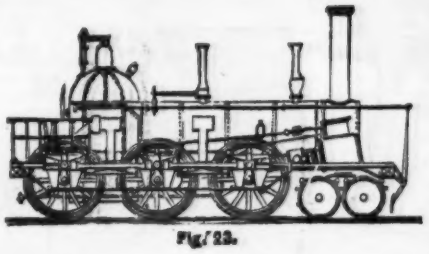


Fig. 22.

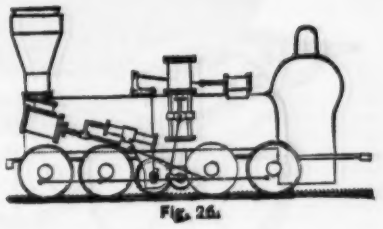


Fig. 26.

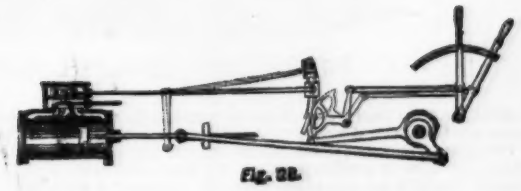


Fig. 28.

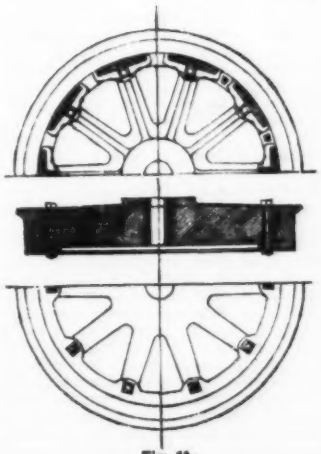


Fig. 11.

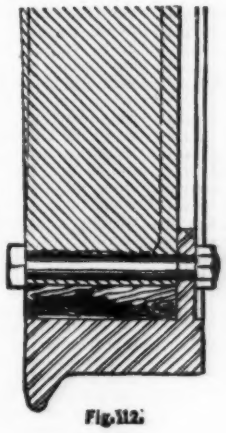


Fig. 12.

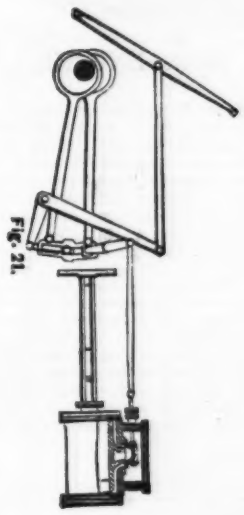


Fig. 21.

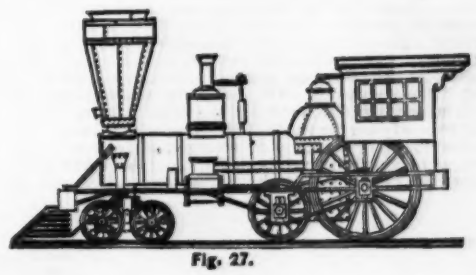


Fig. 27.

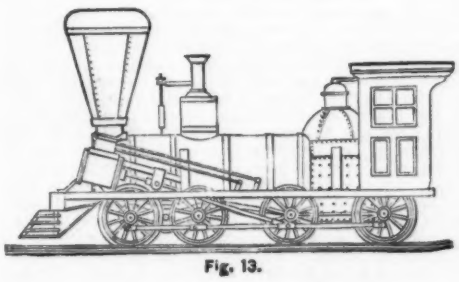


Fig. 13.

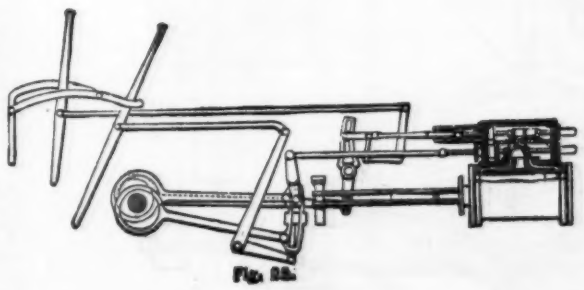


Fig. 23.

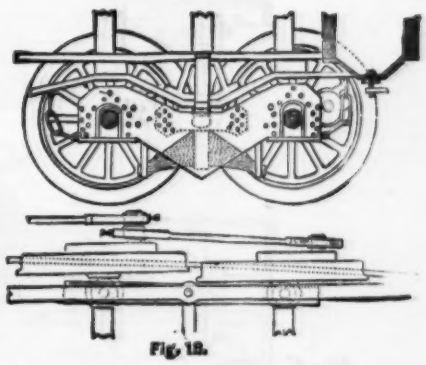


Fig. 18.

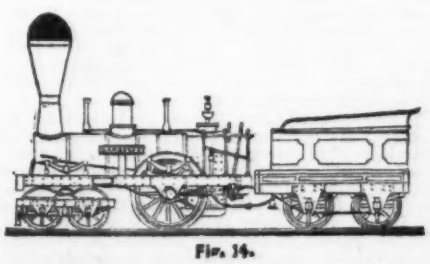


Fig. 14.

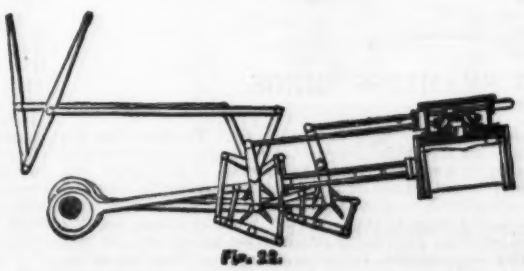


Fig. 22.

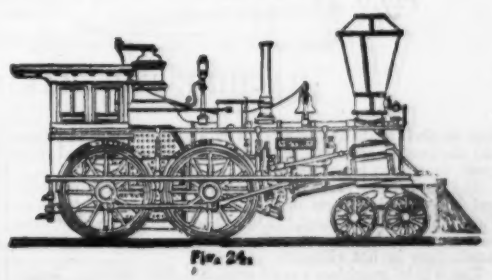


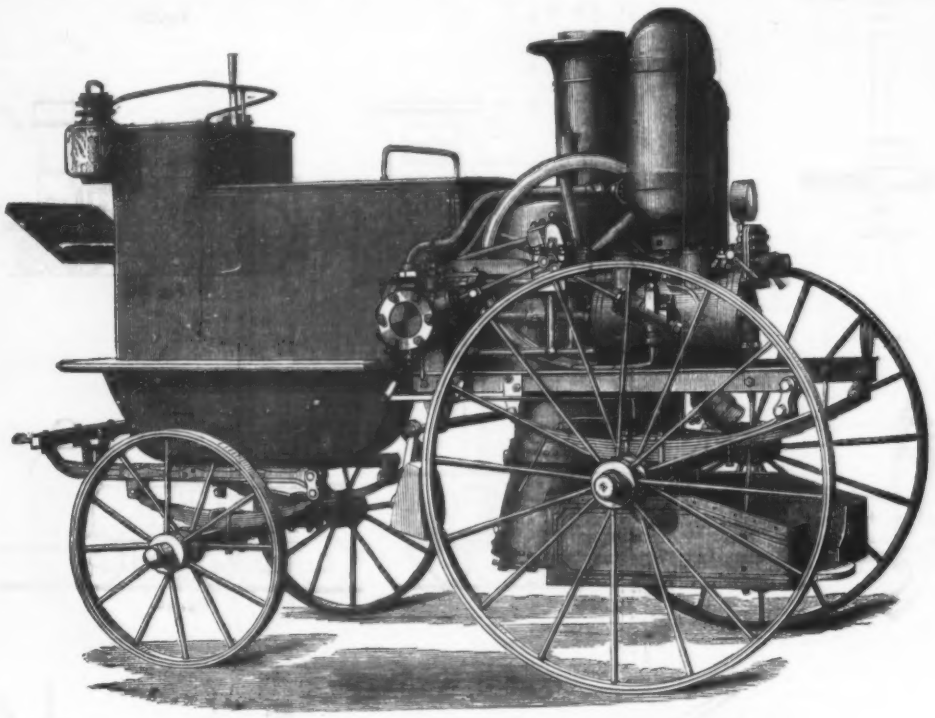
Fig. 24.

ILLUSTRATED HISTORY OF AMERICAN LOCOMOTIVES.

AN ENGLISH STEAM FIRE ENGINE.

IN our SCIENTIFIC AMERICAN SUPPLEMENT, No. 364, we illustrated one of the latest styles of French steam fire engines, and we now present an engraving from *Engineering* of a recent English fire engine supplied by Messrs. Merryweather & Sons to the India Office, for the service of the Kidderpore Dockyard. As the design is in some respects new, and exhibits several novelties in detail, a short description may prove interesting.

The general arrangement is similar to that of the engines supplied by the same firm to the Metropolitan Fire Brigade, London. The boiler is capable of raising steam rapidly, ing about 25 horse power. It has been constructed throughout in a manner suitable for hot climates; the wood hose box is of mahogany, and stoutly clamped with iron, and the rest of the machine is wholly of metal.



IMPROVED ENGLISH STEAM FIRE ENGINE.

while at the same time it is sufficiently capacious to maintain steam steadily when at work.

The steam engine is fixed to one of the side frames of the vehicle, in order to provide room for the large hose and implement box in front, and at the same time to permit of stoking behind. The machinery is made short and compact by the use of a peculiar form of crosshead, which is cottered at one end to the piston rod and at the other slides on the top of the cylinder, and by means of a connecting rod drives a crankshaft placed at a higher level than the piston rod. This enables a connecting rod of considerable length to be used, an important point for steady running at high speeds. The slide valve and feed pump are driven from a crankpin on the end of the crankshaft. The pump and steam pistons are both on one steel piston rod, and the strain is taken by four stay rods between the heads of the pump and cylinder. The suction valves of the pump are arranged in the cover at each end, and the delivery valves on the top of the barrel. The valves are of gun metal with India-rubber faces, and are kept on their seats by springs. Owing to the small air space and the perfect action of the valves, water can be lifted from great depths with certainty.

The pump and valve chambers are entirely of gun metal, and the working parts of the engine principally of steel. The frame is also of steel. The wheels are of wrought iron with gun metal hubs, as wooden wheels are not found to be satisfactory in hot climates.

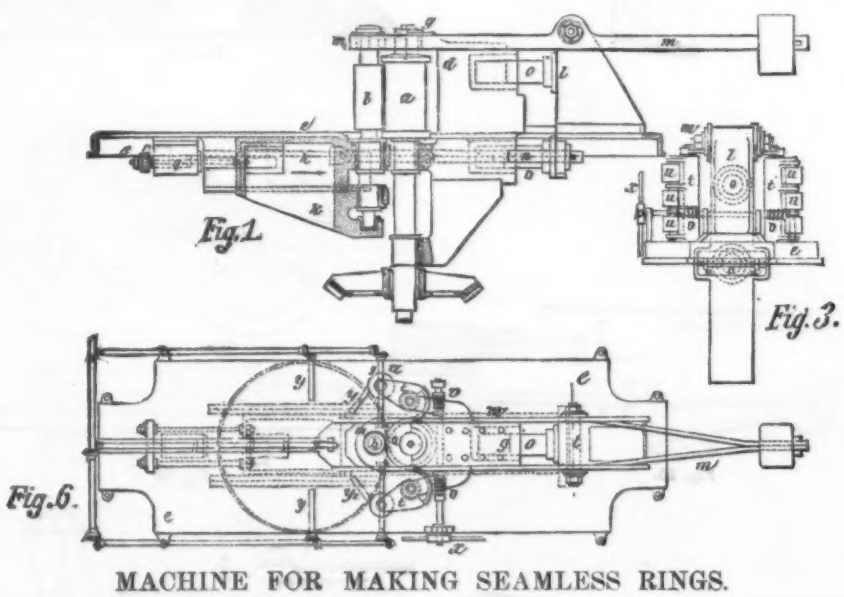
The whole machinery is so arranged that one man, standing at the back, can stoke from the coal bunkers, which are behind, regulate the speed of the engine, attend to the feed, and do everything that is required without moving from his position. The engine is designed to throw 360 gallons per minute; its weight is about 30 cwt., and it is capable of indicat-

MACHINE FOR MANUFACTURING SEAMLESS RINGS.

THE apparatus shown in the accompanying Figs. 1, 2, and 3, has been devised by Mr. Windle, of Moston, for the manufacture of seamless metal rings of all widths.

The cylinder, *a*, which is moved directly by the driving gear, is supported very firmly in the frame, *d*, while the counter cylinder, *b*, rests on a carriage, *k*, which is movable in grooves in the table, *e*. At the opposite end of the frame, *d*, there is an upright support, *l*, which likewise slides on the table, and the upper extremity of which receives the axle of an oscillating frame, *m*, that forms a half bearing, m_1, for the cylinder, *b*. The upper bearing of the cylinder, *a*, is carried by a forked appendage, *g*, to the frame, *d*.

In order to roll rings without seams, the frame, *m*, is raised in such a way as to push the previously prepared hollow metallic piece on to the cylinder, *b*, and the bearing, m_1, is depressed. Through the rotary motion of the cylinder, *a*, the metal is gradually converted into a ring which becomes larger and larger, the cylinder, *b*, being constantly pressed against the cylinder, *a*, by the following arrangement: In the frame, *d*, there are placed two hydraulic cylinders, whose pistons, *o*, are affixed to the sliding support, *l*. This latter is connected, through rods, *n*, with the front carriage, *k*, in such a way that the latter is carried along when the sliding stock, *l*, moves to the right, but so that the carriage, *k*, may



MACHINE FOR MAKING SEAMLESS RINGS.

move toward the right independently. To effect this, the rods, *n*, are free in the grooves of the carriage, *l*, but are held therein by a wedge. When the pistons, *o*, are thrust progressively toward the right, by means of hydraulic pressure, the cylinder, *b*, is shoved up against the cylinder, *a*, until the metal has the thickness that it is desired that the ring shall possess. In order to facilitate the motions of the ring during the operation, the apparatus is provided with cylindrical guides, *y* and y_1, the former of which are connected with each other by gearings, and are set in motion by the machine or by hand. For the purpose of properly centering the ring, that is to say, for obtaining its center on the prolongation of the central lines determined by the cylinders, *a* and *b*, it is conducted on the two sides by a certain number of rollers, *u*, that are arranged one above the other. All these rollers are supported by frames, *t*, which revolve around their fixed axes by means of a worm, *v*, actuated by the hand wheel, *x*, and a toothed sector. The guiding of the ring is thus very easily effected during the running of the flatting cylinder.

When the ring has reached the required diameter, the entrance of water to the hydraulic cylinders is shut off, and this brings about a stoppage of the carriage, *k*. After the piece has again passed between the cylinders a few times, the carriage, *k*, along with the cylinder, *b*, is drawn back by means of a hydraulic press, *r q*, adapted to the table, *e*. The cylinder, *q*, of this press is fixed to the table, *e*, while the piston rod, *r*, is connected with the carriage, *k*, by means of its cross head, *s*, and a link. It results from this that when the piston, *r*, is thrust toward the exterior it causes a recoil of the carriage, *k*, and, at the same time, of the carriage *l*. This press serves, then, to lock the cylinders and to fix the bearing, m_1, on the cylinder, *b*, again. The entrance of the water which exerts the pressure is regulated in the usual way.

The cylinder, *a*, is provided with a flange at each of its extremities, while the cylinder, *b*, is plain. Under these circumstances the ring will be plain; but, if it be required to be furnished with a flange, or to be shaped in some special manner, the cylinders are given a suitable profile to effect the desired end.

The metal to be used for forming the rings is prepared by stamping out a hole in a metallic disk, and afterward forging the latter under a power hammer, by means of a mandrel, into a hollow cylinder of the width of the ring to be made.

FLYING MACHINES.

LAST week we noticed a curious little book by an author who has not thought good to make his name public. We have said of this book that it is a prose poem, and this we think may be held of a great deal that has been written concerning flying. In all ages man has desired to emulate the bird. Indeed, it would not be too much to say that for five thousand or six thousand years he has been trying to fit himself with wings which will carry him through the air. Persistent failure has attended every enterprise of this kind; and the hopes which have been formed that the constructive powers possessed by modern engineers would solve the problem have all been disappointed. We are probably no nearer to flying now than we were a thousand years ago; yet the questions unsolved are not without interest, and it may even serve a good purpose if we place before our readers a few truths which are constantly overlooked by laborers in this particular path of mechanical enterprise.

It is generally assumed that because birds can fly men ought to be able to fly. The operations effected by the bird as just as mechanical as those of the man who walks on dry land or swims in the sea. If only we could perceive precisely what it is a bird's wings do, then we could fly. Now, this seems to us to be a very specious and shallow argument. It is not probable that there is anything occult or mysterious about the action of a bird's wing. So far as the slower birds, such as the rook, are concerned, it is very easy to watch every movement of the wings, and we believe it is more than probable, not only that the wings of many model flying machines act just as do those of the rook or other birds, but that, as far as mere ascension is concerned, almost any species of wing action will serve. For example, we may cite the sixpenny toy called a "flying bat," which is nothing more than a very light screw propeller. This will rise nearly a hundred feet in the air if well made, flutter about for a while, and descend. The wing of a bird offers less resistance to the air when it ascends than it does when it descends; and furthermore it is quite probable that in all cases, and it is certain that in some cases, the down stroke is made far more rapidly than the up stroke, and produces thereby a stronger reaction. This seems to be the whole secret of wing action.

When we come to deal with the elegances, as we may call them, of flight, we have to do with the idiosyncrasy of the flier. The rook may be said to resemble a heavy Dutch farmer, skating to and from market in straight lines, while the swallow is like the most accomplished figure skater that it is possible to imagine; or, put in another way, we may compare varieties in styles of flying with varieties in gait. The hippopotamus, for example, can walk and even run—so can the deer. In both cases the processes, as a series of mechanical operations, are very similar; but from any other point of view they are quite different. We have no doubt that if men could once fly, we should soon have as many styles developed as there are men. If then, it may be urged, there is nothing mysterious about wing motion, and a simple up and down flapping will at least suffice to raise a bird in the air, why should not men fly? The answer is that they are not strong enough. If we consider birds as machines, we see in the first place that they are all comparatively small. There is no bird of flight which weighs as much as even a very light man; but there are many birds which are far stronger than men. The albatross, is, we believe, the largest—we do not mean the heaviest—bird of flight in existence. Its wings measure sometimes as much as 13 ft. from tip to tip, but the total weight of the bird seldom if ever exceeds 28 lb., or one-sixth that of a powerful man. But the albatross can keep its wings in motion for a whole day, while the strongest man would be exhausted if he had to keep beating the air with them for half an hour. There are many birds with limited or no powers of flying which weigh much more; but we shall not be far wrong if we say that the maximum weight of any natural flying machine, which can fly well, does not exceed, say, 30 lb. Now this is a very important truth, because it goes to show that that is about the limit of weight beyond which the air cannot be utilized for bird flight.

Nature does not make many mistakes; or, in other words, the conditions under which species are developed are such that everything goes as far as it can go in size and speed. If it cannot go further, that is because certain conditions interfere to prevent it. If it were possible, we should have birds much larger and heavier than the albatross, or the condor, or the eagle. We may rest certain that the roc of Eastern story is a mechanically impossible creature. The reason why huge birds do not exist is this: It is well known that the strength of every machine rapidly decreases as it increases in dimensions. Thus, for example, the crank-shaft and other parts of a model steam-engine, if all made to scale, are immensely stronger than would be those of a similar engine made with the same proportions, and, say, twelve times the size. Let us apply this to the albatross, and suppose that its wing, instead of being some 6 ft. long, was 12 ft long. All the bones being doubled in length, would be doubled in weight; but they would also have to be at least doubled in strength, which represents another duplication; so that an albatross with a spread of wing of 26 ft. instead of 13 ft. must weigh, not 28 lb., but four times as

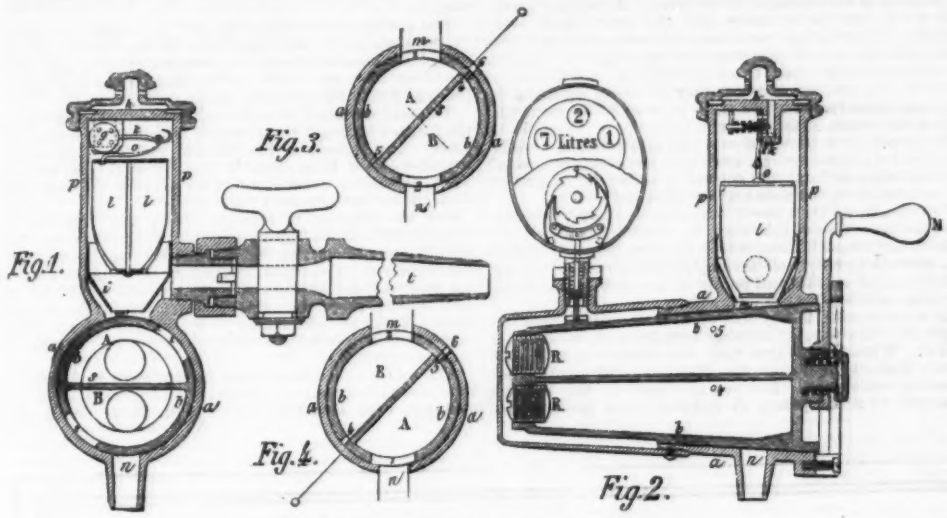
much, or 112 lb. at the very least. Nor would the augmentation stop here, for the area of the wing would have to be altered. Merely to double its length would not suffice; its breadth must, *cæteris paribus*, also be doubled, and thus we have four times the area; but this would again double the strength or weight of the bones, and a very little calculation will suffice to show that a bird with a spread of wing of 28 ft. could not weigh less than 2 cwt., instead of 28 lb. Next comes the question, is it possible to get as much power in proportion out of 2 cwt. as we can out of 28 lb.?

A great deal has been written from time to time about the effect of the wind on inclined planes in keeping birds afloat in the air. Those who have a competent knowledge of the laws of dynamics are, however, aware that the inclined plane action cannot alone keep a bird from falling to the ground. The action is at best just that of the wind on a kite; and the equivalent of the string must be provided or the bird will be carried away, just as a kite is when the string breaks. Birds, when sailing, are either going with the wind or are using up momentum acquired by previous rapid motion. The work done by the bird will vary continually; but it is strictly analogous to that of a swimmer, who, carrying a load, has to keep himself afloat by his own exertions. There is no way out of this. Nothing is got from the air in the way of help, save when upward currents strike the flying bird; and that such currents exist, every engineer who has seen the decking of a bridge lifted in a gale well knows. Returning, then, to our albatross, the work it does is equivalent to continually lifting 28 lb. The idea that the bird is buoyant in the air is a delusion. If it weighs dead 28 lb., it will weigh living 28 lb., and the variation in the displacement of the dead and living bird cannot represent more, at the most, than an ounce. In round numbers, 13 cubic feet of air weigh 1 lb. The albatross, therefore, represents no less than $13 \times 28 = 364$ cubic feet of air while its entire displacement is, probably, at most 4 cubic feet. An increase in dimensions of one-fourth when alive as compared with the same board dead, would represent about $\frac{1}{16}$ of its weight saved by extra buoyancy, which is nothing. The weight of the bird, then, may be regarded in exactly the same light as the weight on a brake driven by a portable engine. The brake wheel is always trying to lift it up. The power expended is measured by the distance passed over by any point in the rim of the brake wheel in one minute, multiplied by the weight and divided by 33,000 per horse-power. Now, if we could tell the distance passed over by the bird's wings at each stroke, and the number of them, we should, knowing its weight, be able to estimate the power expended. We cannot do this in the case of the condor or albatross; but, bearing in mind the small specific gravity of air, we shall not be very far wide of the mark if we say that an albatross probably possesses as much muscular energy as a man. The utmost load that a man working at a crane cradle can put forth for a day's work is 20 lb. at a crank handle, making about 3 ft. per second; and nearly all the muscles of the body are engaged in this work. It will be seen that if even half this work is got out of the very much smaller muscles of the albatross, the energy of the muscles, on whatever it depends, must be very much greater than it is in man. The pectoral muscles of the swallow weigh much more than all the other muscles in its body put together, and in all birds which fly well, it will be found that the muscles actuating the wings are relatively enormous in dimensions. But not only is this the case; the bird works at a higher pressure, if we may use the words, than any other animal. Its temperature is considerably above 98°, that of man and the mammalia generally: and all the swift birds live on food capable of giving out much energy, while concentrated as to dimensions. Thus the swallows, eagles, hawks, vultures, etc., are all carnivorous. Again, it will be found that the arrangements for aerating the blood in birds are extremely complete, and this is one reason, no doubt, for their high temperature. In other words, we have in the bird a machine burning concentrated fuel in a large grate at a tremendous rate, and developing a very large power in a small space. There is no engine in existence, certainly no steam engine and boiler combined, which, weight for weight, gives out anything like the mechanical power exhibited by, let us say, the albatross.

It is, then, simply for lack of muscular power that man can never fly. There is no combination of wings or arrangements of any kind which will compensate for this fact. Whether he can produce a machine to supplement his own want of force remains to be seen. Such a motor cannot, we think, be driven by steam. It is, however, not impossible that a machine might be made which would be caused to fly by means of a small electric motor run at a very high speed and worked by the aid of a couple of wires from the ground. This, however, would hardly be flying in the true sense of the word. That wings and such like things can be made, we have no doubt; and experiments enough have been made to prove that, if power enough be available, flight can be achieved. When a machine can be made, each pound of which will develop as much energy as each pound of a bird, flying may be possible—not till then.—*The Engineer.*

HELBING'S LIQUID METER.

MR. HELBING'S liquid meter, which is shown in the accompanying Figs. 1, 2, 3, and 4, consists of a stop-cock box, *a*, which is connected by means of a conical tube with the cask or other vessel containing the liquid to be measured. In this box there revolves a plug, *b*, which is bored out accurately, and the hollow interior of which is divided into two (usually equal) parts by a partition running through the axis. The two compartments thus formed are entirely distinct and are utilized for measuring, their contents being regulated exactly by means of strong screws, R, that are inserted in the extremity of the plug, and that are soldered in case the apparatus is to serve as a gauge. The rotary motion of the cock is effected by a winch, M, and is limited by two stops so that, in each of the extreme positions, one of the measuring chambers is filling while the other is emptying, as shown in Figs. 3 and 4. There is thus no loss of time.



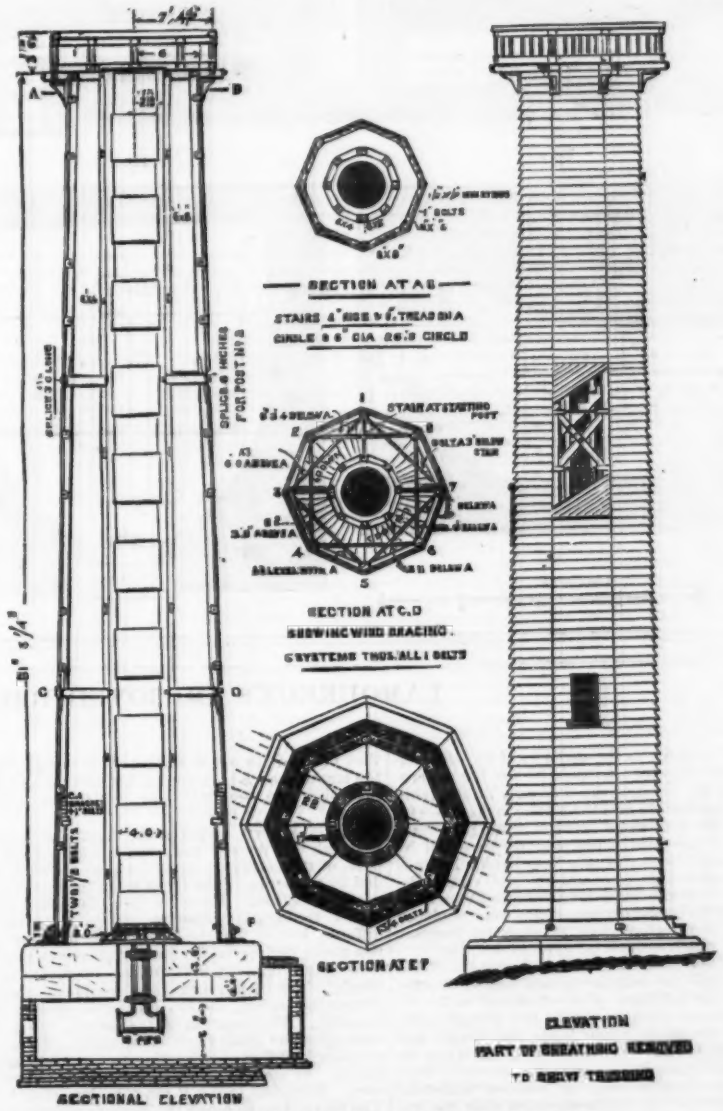
HELBING'S LIQUID METER.

It is necessary that the air shall be able to disengage itself easily from the compartment that is filling, and that it shall enter readily and rapidly into that which is emptying. The second condition is fulfilled in the simplest manner by boring holes (4 and 5) in the plug for each compartment. These holes are usually closed by the box or shell containing the plug, and correspond with a similar hole (6) in the shell when the liquid is to make its exit from the measuring compartment through the pipe, *a*. But the first condition is more difficult to fulfill, because a direct communication with the air cannot be established, and, without this, when the air became disengaged, the liquid would overflow. With the shell, *a*, there is connected another cylindrical one, *p*, through which the liquid enters the measuring chamber, and in this shell, *p*, there is a funnel, *r*, which is so arranged that the liquid shall surround it and be introduced through an annular surface, while the air may be disengaged freely through the interior of the said funnel. In this same shell, *p*, too, there is suspended a float, *l*, which may be readily connected by a lever arrangement, *o k*, with a small revolving disk, *g*, that is fixed to the side of the shell. This disk, *g*, contains several apertures that correspond with others in the cover, A, of the shell, and, consequently, with the open air, as long as the float occupies its lowest position, so that the air can then make its exit from the measuring chamber through the funnel, and pass between the float and the shell to become finally disengaged through the apertures in the disk, *g*. As soon as the measuring chamber is full, the liquid rises in the funnel, raises the float and thus closes the apertures, prevents the exit of the air and stops the entrance of the liquid. As soon as the second measuring chamber becomes empty to the top, the liquid flows from the funnel into it, and the float descends and thus automatically opens communication with the external air.

As the liquid must always enter as far as the float box in order to close the apertures through which the air escapes, the measuring chamber is constantly closed in the revolution of the cock in the interior of the liquid, so that in all cases exactly the same quantity is measured in a manner that is entirely independent of pressure. Connected with the apparatus there is a counting mechanism which gives directly the number of liters measured, and not the number of motions of the winch. The apparatus, which, in its entirety, is very strong, is constructed with great care. Wear produces no change in the dimensions of the chambers, and this secures great durability to the apparatus.—*Wochenschr. des Ver. Deutscher Ingenieure.*

CALUMET MINE STAND PIPE.

THE conditions under which this structure had to be built were such as do not in this country obtain for stand pipes, which are usually buildings of such a permanent character as need to be constructed in a very solid style; but although the exposed position of such a tower at the Calumet Mine, which is subject to the very violent storms that sweep across Lake Michigan, rendered necessary a very strong structure, yet the intense cold of the northern winter, frequently reaching 40 degrees below zero, is best resisted in such a case by sheathing the stand pipe with wood. This material has also



CALUMET MINE STAND PIPE.

the merit of cheapness; thus the present design was made to meet the several demands upon it, a minimum of iron and stone work being made use of. The object of the tower is primarily to raise the available head of water in fire emergencies, when in the case of such an isolated community as this the property would be entirely dependent on its own resources. The wrought iron tube, 80 feet high, having the lowest seven plates of $\frac{3}{8}$ inch thick, the next seven of $\frac{1}{16}$

inch, and the top seven of ¼ inch, is riveted to a "gun iron" angle ring at its foot, which is bolted to a casting forming a base for it and part of the vertical framing. Through a nozzle in this base communication is made with the water supply pipe, which runs through the tunnel in the foundation.

The octagonal framing around the tube has the inner sticks of 6 inch by 6 inch section, and the outer, which are adzed to the octagonal shape, of 8 inch by 8 inch stuff. A spiral stairway is carried round between the inner and outer framings, which are thus tied somewhat together, being also bolted together at the spliced joints. The frame legs stand in cast iron boxes on the base plates, and besides being bolted through to them, the outer legs are held down by long vertical bolts taking on to a toothed bracket bolted on at some distance up the leg. The vertical tube has no staying, being clear of the wood framing all round. The whole framing is braced diagonally, and 1 inch bolts pass round the whole eight posts, engaging in straps cut into them. The structure is sheathed diagonally with 1 inch stuff nailed on, which is then covered with ½ inch clapboards. The whole is calculated to resist wind pressure of 50 lb. per square foot.

The materials used were all woodwork, 10,100 feet board measure; all ironwork, including all bolts, 40,000 lb. weight; cost of ironwork, $2,100. It is possible that a strong yet cheap tower of this description might be found to fulfill all the necessities of some small towns, and certainly of large isolated works in this country, and for this reason we illustrate it.

LAMOUREUX'S IMPROVED BREAD OVENS.

IT will be remembered that in the Lespinasse system of oven (which the inventor was commissioned by the War Department of France to apply in the majority of its establishments, and which has also been adopted by foreign governments) the external air reaches the fuel only after having been heated under the hearth, and the smoke makes its exit only after having made numerous circuits through certain conduits formed over the vault. The heat is preserved by layers of sand under the bricks of the sole, which latter is slightly inclined from the back toward the entrance. Recently, this system of ovens for baking bread, although recognized as superior to its predecessors, has been replaced by the Lamoureux oven, which has an external fireplace heated by coal, and which we now propose to describe.

The Lamoureux Generating Oven (Figs. 1 and 2).—This oven recalls in principle the ordinary system heated directly by wood, but with the addition of a cylindrical boiler, *b*, half full of water, placed directly over the low-arched vault, V, in a horizontal channel, *e*, which leads the flames and hot gases to the chimney, *d*; the latter, as in old styles of ovens, being situated immediately over the mouth. Two copper tubes, *a*, fixed longitudinally in recesses under the wall of the vault, are put in communication with the extremities of the boiler in such a way as to set up a continuous circulation.

This application, for which the inventor obtained a patent in 1877, is designed to utilize a portion of the heat expended so as to heat the water necessary for the operation of panification, and, if need be, to create the quantity of steam necessary for supplying a small engine capable of actuating a pump for lifting water, or a mechanical kneading trough.

To this end, the generator and its tubes present a heating surface of more than five meters square, so that, reckoning only on a temperature of 150°, it will be seen that it is possible to produce a 5 or 6 horse-power in allowing nearly one square meter per horse.

It is true that some bakers, who are not in favor of mechanical work, object to the use of this generator on account of the fact that it is necessary to use more fuel and to employ more time for heating, and that a greater irregularity in temperature is to be feared; but, in our opinion, it is evident that the slight excess in the use of fuel and expenditure of time is well compensated for by the advantage obtained in the substitution of mechanical for manual power, and that, with intelligence and care, just as much regularity ought to be secured in the operation of the oven. As regards execution, we do not fear to assert that this oven offers every security. The front is provided with frames and cast iron plates that give it all the strength that could be desired. Toward the extreme end, there are channels, *o*, likewise of cast iron, the aperture of which may be easily regulated by dampers, maneuvered by a rod, *p*, in front of the oven, and within easy reach of the workmen.

The generator is provided with two safety-valves, a water-level, and a pressure gauge, exactly as are steam-boilers, all of them being in front and constantly under the inspection of the foreman of the shop and the workmen.

The sole, S, which is paved with care, is slightly inclined, as in the best ovens of this kind, in order to facilitate the service. Its rounded form, which has been perfectly studied out, resembles pretty well the longitudinal section of an egg, and permits of reaching all points of the surface, and also the edges as nearly as possible.

As we have said, this system of oven is heated precisely as are the old styles, by burning very dry split wood on the hearth. When it is judged that the temperature is sufficiently high, the live coals are allowed to fall in front into an extinguishing box. Keeping up a light in the interior, by means of a few pieces of burning wood, the workman then proceeds to put in the loaves of bread, beginning with the larger ones, which are pushed toward the back, and ending with the smaller ones, which are placed near the mouth.

As well known, owing to the high temperature to which the vault and floor of the oven are raised, all the external parts of the loaves are acted upon by the heat, and are modified by the action of the latter upon the starch, and in a manner caramelized. There is thus formed a colored crust, which, through its cohesion, maintains the forms given the different loaves. In the interior the temperature does not rise above 100°, owing to the abundant evaporation of water. This latter temperature suffices, however, to solidify the dough. The steam and gases are disengaged in great part during the baking, and also during the cooling, but in smaller quantity. The duration of the baking has a marked influence upon the quality and composition of the bread, and is necessarily different according to the forms and sizes of the loaves. In general, it varies from thirty to seventy-five minutes. For small loaves it must be less than for large ones. The loaves lose so much the more in weight in proportion as their surface is greater, and, consequently, in order to obtain a definite weight, different quantities of dough must be used for each sort. It is not difficult to arrive very approximately at an exact weight, and yet this never takes place in practice, and still less so since the liberty accorded to bakers.

We do not know the daily quantity of fuel consumed by such an oven, but in the Lespinasse oven there are burned on an average 15 kilogrammes of wood for the baking of 100 kilogrammes of bread. Now, we do not think that the oven under consideration can consume less.

Lamoureux's Oven with External Fireplace (Figs. 3 to 6).—This oven is shown in section in Fig. 3. Fig. 4 is a transverse section through the line 1-2. Figs. 5 and 6 are horizontal sections made respectively at the level of the lines 3-4 and 5-6, the first showing the arrangement of the heating apparatus, and the second the form of the sole. The fuel, which is usually coal, is spread over a grate, K, which is placed to the side, at the extremity of a conduit, L. The latter is arranged in serpentine form, M, under a chamber, O, called the heating chamber, from which it is separated only by a thickness of eight centimeters. The fuel is introduced over the hob, J, and the entrance of air occurs through the box, I.

The products of combustion, after traversing the chamber of the fireplace, L, and the worm, M, rise through the conduit, E, to a second worm, G, arranged at the upper part of the oven over the vault and ending in the chimney, H, through which the products escape.

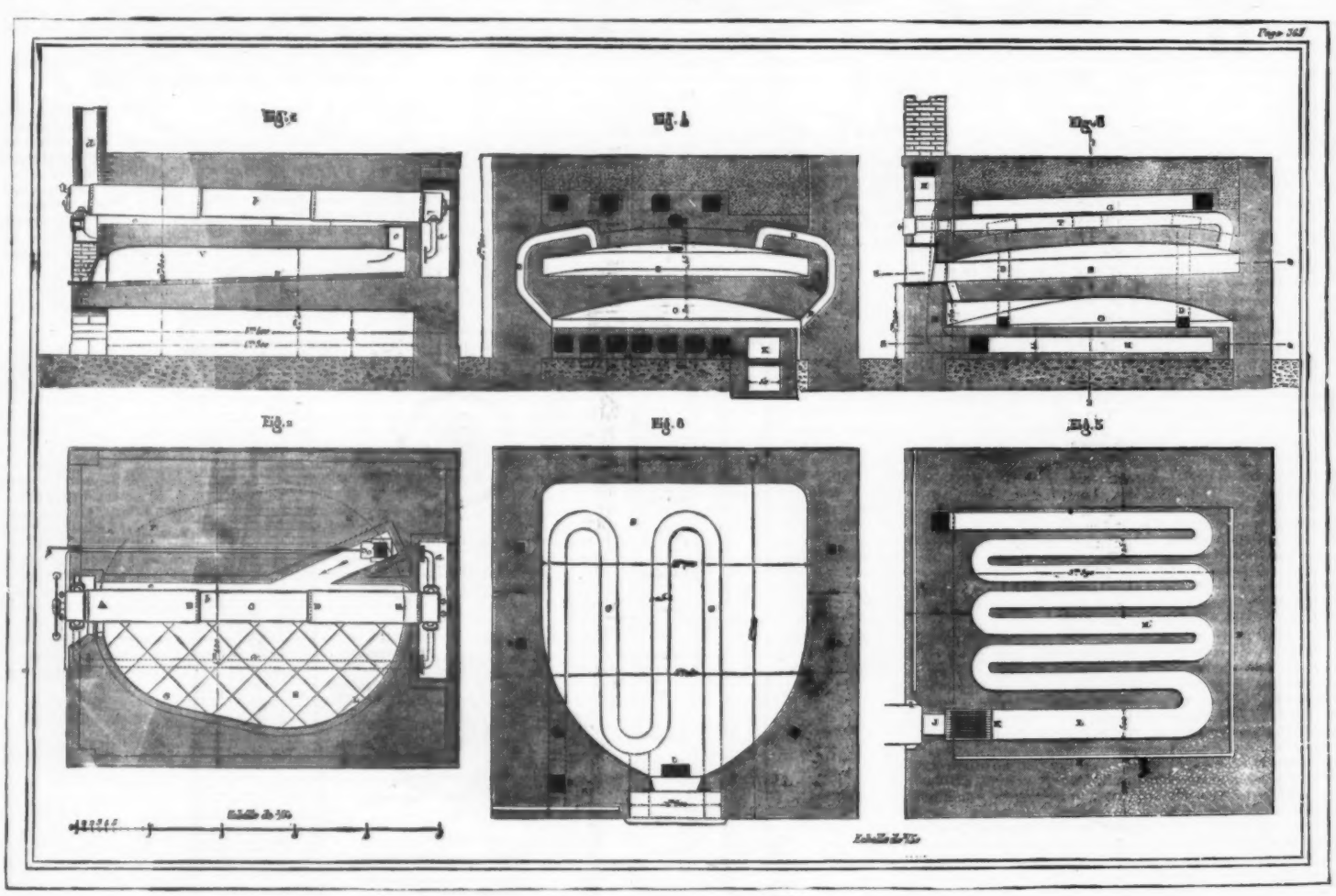
The heat chamber, O, communicates with the entrance of the furnace through the conduit, U, which is covered by a grate. The air, which has become heated by contact with the sides of the serpentine, M, rises through the four conduits, D, which, debouching in the vault of the oven, introduce the hot air necessary for baking.

For the purpose of rapidly cooling the oven, there is formed, between the upper serpentine, G, and the vault, a conduit, T, which, starting from the front of the oven, ends in the interior at its opposite extremity. In order to prevent a too great heating of the front, which would render working troublesome, there are formed, between it and the masonry, spaces, F, for the circulation of air, and the sides of the serpentine are also isolated by empty intervals, N, in which the air can circulate.

The sole is of peculiar form, being neither circular nor oval, but having the arrangement of an ogive in front and of a rectangle with rounded corners at the back. Such an arrangement permits of obtaining a very regular temperature, that may be regulated at will.

The heat chamber is separated from the flues of the serpentine only by a thickness of one brick, making it thus easy to reach the flues and repair them by entering the chamber through the front, and demolishing a small portion of the masonry, which is so constructed that it can be removed without trouble. As for the flues of the upper serpentine, it is only necessary to disengage them from the layer of sand to expose them so as to repair them. These flues are swept out from in front after demolishing a little of the masonry in their prolongation.

This oven, applied at the military station of the *Quai de Bilby*, has given satisfactory results. The baking of bread and biscuit for three hundred rations was in every respect comparable with the results obtained with the Lespinasse and ordinary ovens. These results, however, were not obtained at once, for the inventor was obliged to demolish a portion of the oven in order to change some of its dimensions.—*Machines, Outils et Appareils.*



LAMOUREUX'S IMPROVED BREAD OVENS.

TURNING ELLIPSES IN A LATHE.

To the Editor of the Scientific American:

I observe an article published in the SUPPLEMENT, 367, dated Jan. 13, 1883, in reference to turning ellipses in a lathe, and credited to the *Revue Industrielle*. The article in question and the principle involved were first published by me in the February number of the *Journal of the Franklin Institute*, 1881.

FRANK M. LEAVITT.

Philadelphia, January, 1883.

RICHARD TREVITHICK.

NEARLY fifty years have passed since the death of one of the greatest engineers and most fertile inventors that the world has ever seen, but to whose talent and labors scanty justice has been done, save perhaps in his native country, and in a memoir published some years since by one of his sons. Richard Trevithick was indeed a genius, with all the weakness as well as the strength of character usually combined in men of extraordinary ability, and his extensive and varied engineering works wholly uninfluenced by precedent, for few then existed, were characterized at all times by sound judgment, originality, and skill. Springing from a comparatively humble origin, during his career he won fame abroad and in his own country; but he died in poverty, and was buried by charity in an unmarked grave.

We are glad to see that efforts are now being made to rescue this noble name from the oblivion into which it has been allowed to sink, and this year—the fiftieth anniversary of Trevithick's death—has been chosen as a fitting time to erect to him a worthy and lasting memorial. Few persons know anything of Trevithick's career, and that the leading incidents of his life may be brought prominently before the public to increase their interest in the memorial work now on foot, we propose briefly to review the principal incidents of his laborious and useful life. Richard Trevithick was born on the 13th April, 1771, in the parish of Illogan, Cornwall. In very early life he became familiar with mining work, and with the rudimentary pumping engines erected by Newcomen, as well as with those of Boulton and Watt. His father, who was a mine manager, had considerable engineering abilities, and one of his successful undertakings was the remodeling in 1775 of an old Newcomen engine, erected about 1730. This engine has been abandoned, but was purchased for about £400 for the Dolcoath mine. The elder Trevithick supplied new self-acting valve gear, he replaced the granite slabs of the original boiler by semicircular iron plates, and the cylinder was placed on an independent foundation; this may be considered the first step in the use of high pressure steam. About 1776 Watt made his appearance in Cornwall, and laid the foundation for the considerable business his firm carried out in mine engines; he also laid the foundation for the animosity that, established with the father, was to be continued with the son through almost the whole of the career of the latter.

When eighteen years of age, Trevithick was employed in a responsible position under his father at the Stray Park mine, and within five years he and Bull had entered into direct competition with Watt by erecting new engines and altering old ones, being paid for their work by a percentage of the saving he was enabled to effect. In 1797 Trevithick was in practice as a mechanical engineer, supplying machinery, and having mechanics at work in at least twenty mines; he was then steadily working his way to high pressure engine construction, and standing up to the long costly fight over patent rights with his rivals, Boulton and Watt. In 1800 he built a high pressure portable steam engine for one of the Cornish mines; another he sent to London, and the same year he built the first high pressure steam whim. A whim of the same type was still working in 1869 in the original form, renewals have been careful copies of the parts removed. This engine was furnished with steam from a cylindrical boiler with an internal flue, and furnished steam at 25 lb. per square inch. Previous to this date he had made several working models of road locomotives, one of which still remains in the South Kensington Museum; but it was in 1800 that he commenced the construction of the first steam carriage. On Christmas Eve, 1801, the first run was made with this machine, to the mingled astonishment, delight, and fear of the passengers. At the same time Trevithick and Vivian became partners, and journeyed to London to obtain a patent for the steam carriage. The leading features of this machine, for which a patent was granted in March, 1802, were a cylinderical wrought iron boiler, with a return flue, a vertical cylinder partly increased in the boiler, a steam jet in the chimney, and a feed water heater placed around the exhaust pipe. The working pressure was about 60 lb. to the inch. Trevithick at this time was working hard at the design and construction of engines to propel themselves and draw loads upon the common roads and which were at the same time available for various other purposes. In the summer of 1802, he describes the trial of such an engine fitted with a 10 in. pump having a 4 ft. stroke, and working up to 145 lb. pressure of steam furnished from a cast iron boiler with an internal flue, and in the beginning of 1803 he supplied an engine with a cylinder 11 in. in diameter and 3½ ft. stroke, to a gun factory in London for boring cannon. The great success of this revolution in the use of steam began to attract much attention, and offers of large sums were made to Trevithick for fractional interests in the patent of 1802. In 1804 the first tramroad locomotive in Wales was tried, and in a letter referring to this engine Trevithick describes the advantages, he derived from using the exhaust steam as a blast in the chimney. It was about this time that Boulton and Watt, opposing bitterly Trevithick's high pressure system, attempted to obtain an Act of Parliament to prevent more engines on this plan being made, on the ground that the "lives of the public were endangered." At the beginning of 1805 there were a large number of factories occupied in making high pressure engines under Trevithick's instructions, and the district of Newcastle-on-Tyne appears to have had many in use. About the same date he constructed a traveling steam crane for the West India Docks for unloading ships, transferring cargo, and hoisting it into warehouses, and having provision for driving a pump in case of fire. Want of space prevents us from following Trevithick in his progress with high pressure locomotive engines in the north of England, and we cannot do better in reference to this part of the subject than quote an extract from the columns of this journal published in our issue of March 27, 1868: "Trevithick was the real inventor of the locomotive. He was the first to prove the sufficiency of the adhesion of the wheels upon the rails for all purposes of traction on lines of ordinary gradient, the first to make the return flue boiler, the first to use the steam jet in the chimney, and the first to couple all the wheels of his engine." Besides locomotives, rolling mill engines, pumping and hoisting engines, etc., Trevithick turned his attention with success to the construction of steam dredgers, subsequent to his having employed a water wheel at Blackwall to break up the bottom at the entrance of the East India Docks. In 1806 he entered into negotiations with the Trinity Board to raise from the bed of the Thames 500,000 tons of ballast annually at a price of 6d. a ton, and during a period of twenty-one years. At this date his steam dredgers were in successful operation, the first of a class of machines that have since his time found extensive application all over the world. At the time when Trevithick was actively employed in dredging the Thames and in working his engine patents, a company called the Thames Archway Company was endeavoring to drive a tunnel in across the bed of the river, below London Bridge; after several failures, Trevithick was requested to take the matter in hand, and he worked at it for nearly two years, with the actual result of driving the driftway from the south bank to within 70 ft. of the north side. At that point the water broke in, and the work was ultimately abandoned through dissensions of the company. In 1808 Trevithick became joint patentee with Robert Dickenson for the invention of iron tanks, and he published a pamphlet about the same time, describing the advantages of water ballast, and the manufacture of iron buoys; he speedily found an application for this new branch of invention by employing iron tanks in raising sunken vessels. Tanks led on to ship construction, and ships to floating docks, and in a comprehensive specification, dated 1809, filed by Trevithick and Dickenson, we find minute descriptions of a wrought iron floating dry dock, of iron ships, iron tubular masts and spars, composite vessels, and appliances for heating and bending timber to any required form. About the same time he submitted proposals for fitting his high pressure engines on board ship as a means of propulsion, by means of a paddle wheel. Subsequently one of his patents describes a screw propeller, which "may be made to revolve in the water at the head of a ship, or at the stern, or on each side." The marine boiler patented in this specification was to be constructed of "a number of small perpendicular tubes closed at the bottom, but all opening at top into a common reservoir, from whence they receive their water, and into which the steam of all the tubes is united."

It is a very remarkable fact, and illustrative of the high order of genius possessed by Trevithick, that in all his patent specifications and in most of the very numerous descriptions he gave his friends of his new inventions, he showed a clear perception of mechanical devices that were in a subsequent generation to receive vast developments. Probably he never suggested or carried out an unpractical idea; on the contrary, his capacity for embodying his inventions was limited only by the means at his disposal for putting them into execution.

Before passing on to some of the more salient features of Trevithick's career, which may be said to terminate with his unlucky determination to go to South America, we may notice briefly some of his more miscellaneous inventions. Among these were a stone crushing mill with cast iron rollers, driven by one of his high pressure engines; iron rolls for crushing sugar cane, and grinding clay for china manufacture. He also busied himself in improvement in blast furnaces, copper smelting, brewery plant, breakwater construction, and rock boring machinery.

Debts and other difficulties constantly attended Trevithick, and in 1809 a distress warrant levied on his property swept away a valuable accumulation of drawings, models, and manuscripts, which were all irretrievably lost, so that it is only since 1812 that a complete record of his work remains. In that year we find him applying steam power to thrashing machines, and hiring out and selling engines for sawing, chaff cutting, reaping, and grinding, as well as for plowing and working his digging machines and harrows. Six years earlier, as we have seen, he had experimented with traction engines, when he hauled four wagons, each loaded with 2½ tons, and carrying seventy men, for a distance of about ten miles at a speed of four miles an hour. These promising experiments he abandoned in consequence of the indifference shown in them, although, as he tells us, great curiosity was evinced, and the trial referred to was carried out in the presence of 10,000 spectators. In the same year he was building engines for driving sugar mills in the West Indies, designing a traction engine, also for the West Indies, for traveling from plantation to plantation, in which no condensing water was required, and also a thrashing engine for Lord Dedunstanville in Cornwall. The following year we find him busy adapting a plowing engine for pumping water out of the foundations for a new bridge at Exeter, as well as making other engines for the West Indies, preparing for a number to be used at the Plymouth breakwater, and constructing thrashing machines, which appear to have been very successful, since the first he erected was worked by a laborer for eighteen months without requiring any repair; the duty obtained with them averaged 1,000 sheaves an hour with 25 lb. of coal. Several of these engines were kept at work for many years, some as recently as 1854. About the same time, or probably a little earlier, Trevithick was busily occupied with designing and constructing high pressure pumping engines of a more developed type. Indeed, about 1812 the Wheal Prosper Mine in Cornwall was supplied with an engine working at a pressure of 100 lb. to the inch, with a cut-off ranging from one-eighth to one-quarter. Steam was supplied to this engine from two wrought iron boilers, 3 ft. diameter and 40 ft. long. A larger one was built for the Herland Mine in 1814, working at 150 lb. pressure, supplied from internally fired boilers, 5 ft. 6 in. diameter and 40 ft. long. It is worth remarking that these boilers were made from hammered plates 3 ft. long and 1 ft. wide. Various other engines of this class were fitted up about the same time; at Saltram, Tavistock, Beeralstone, the Fowey Consols Mine, Treskerly, Poldice, etc. One engine made in 1812 for the Old Wheal Dannel Mine, was working there as lately as 1865. Between 1812 and 1816, Trevithick was much occupied in building pumping engines for Peru, and indeed he had shipped in 1814 no less than £16,000 worth of machinery, including nine pumping and winding engines, ore reducing mills, etc. Two of these engines were at work in 1872, supplied with steam from the original boilers, 5 ft. 6 in. in diameter, 30 ft. long, and $\frac{7}{16}$ in. thick; they were then worked at 40 lb. pressure. In the mining venture for which this machinery was destined, Trevithick embarked with golden anticipations of realizing £100,000 a year from his share. These anticipations were never realized, indeed the whole scheme fell to the ground after years of labor and expenditure on the part of the great inventor, whose brilliant career was fatally interrupted by this enterprise.

In the autumn of 1816, Trevithick left Cornwall in a South Sea whaler, and reached Lima in February, 1817. Four years' hard work at the Peruvian mine terminated disastrously, and from various causes, in 1821 Trevithick found himself penniless in Lima; thence he was sent to Bogota in Colombia, on a special mission for Bolivar, the republican governor of Peru, but stopping at Guayaquil he heard rumors of rich mines in Costa Rica, and made his way thither. Four or five years he spent there with no success, but doubtless much rough adventure, and in 1826 or 1827 he left the mines to find a new route over the Cordilleras to the Atlantic coast, a task accomplished in about three weeks, in the face of almost unsurmountable obstacles. Making his way to Carthagena, he fell in with the late Robert Stephenson, when in dire distress, by whom he was but coolly received; Stephenson, however, gave him money to return to England, where he arrived in October, 1827, having thrown away eleven of the best years of his life. Probably demoralized by his adventurous life abroad, and quite without means, Trevithick could not restrain from invention, nor hold aloof from the Patent Office, the fees of which he probably found friends to advance. In 1827 he patented a recoil gun carriage in which "the recoil lifted a weight smoothly and without friction; the gun and weight were held in the position arrived at by a catch, until the gun was loaded and ready to fire again." An invitation from Holland to advise on engineering works suited him well, although he had to borrow the money to pay for his journey. Very soon he elaborated a scheme for land reclamation in that country, and a drainage company was formed in London on the strength of his representation, Messrs. Harvey & Co., of Hayle, receiving orders to construct pumping engines; but although this was completed and shipped, the company went to pieces, and the enterprise was abandoned.

Only a few more years were to be allotted to this great and erratic genius, and they produced many pregnant inventions far in advance of the time, and anticipating with more or less closeness engineering practice of the present day. These inventions referred to tubular boilers, superheating steam, surface condensers, warming and ventilating apparatus, marine and locomotive engines, and water jet propulsion, while ten months before his death he submitted a scheme for the erection of an iron column 1,000 ft. high to celebrate the passing of the Reform Bill. Living during the close of his life among strangers, and in the utmost penury, Trevithick died in April, 1833, almost unnoticed. That he did not arrive at wealth and honor was due to the weaknesses of his private character, which overwhelmed his great genius as an engineer. But in spite of his failure of success, he looked back with satisfaction upon his busy and useful life, as is proved by the following paragraph he wrote to a friend a few months before his death: "I have been branded with folly and madness for attempting what the world calls impossibilities, and even from the great engineer, the late Mr. James Watt, who said to an eminent scientific character still living, that I deserved hanging for bringing into use the high pressure engine. This so far has been my reward from the public; but should this be all, I shall be satisfied by the great secret pleasure and laudable pride that I feel in my own breast, from having been the instrument of bringing forward and maturing new principles and new arrangements of boundless value to my country. However much I may be straitened in pecuniary circumstances, the great honor of being a useful subject can never be taken from me, which to me far exceeds riches."

These words, written fifty years ago, at the dreary close of a great career, have borne testimony up to the present time against the indifference and prejudice which, engendered by contemperaneous professional animosity, have been handed down through two generations. To Watt and Stephenson monuments and memorials abound; to Trevithick, who possessed a bolder genius, a more brilliant and fertile inventive brain than either, there has been nothing till to-day but an unknown grave, except that his memory has been kept green in the hearts of Cornishmen. No more praiseworthy effort to restore a great name to its proper place, and to repay the debt which the world has so long owed, has ever been made than that which is now at work to establish a fitting memorial to Richard Trevithick.—*Engineering.*

MR. W. T. HENLEY.

THE history of a modern application of science is found to be an almost impossible task, and yet if there is one thing in which history should be accurate it is in the applications of science in the nineteenth century. The steam engine is practically of the century—at any rate, the locomotive is certainly, while telegraphy is still younger; and that branch of telegraphy which relates to submarine work is still in its infancy. Yet even here those entering this life have little fellowship with those leaving it; and thus the pioneers in these gigantic enterprises are not always credited with the admiration they deserve. Mr. W. T. Henley, who died on December 13, at the age of sixty-nine, and whose funeral took place Dec. 18, at Kensal-green, was closely connected with the birth of land and the birth of submarine telegraphy. The late Mr. Henley was born at Midhurst, in Sussex, and at the age of sixteen, not liking the leather trade, he came to seek his fortune in London. Hard work, first as a light porter at a silk mercer's in Cheapside, then at the docks, did not deaden his ambition, and having an inherent tendency toward light mechanical work, he strove early and late to make himself an excellent workman. He became acquainted with the late Professor Wheatstone, who employed him to construct apparatus; and when the company was formed to introduce the telegraph, he constructed a large amount of the apparatus required, but through a lawsuit about a partially executed order, he lost this connection. In 1852 a company was formed to work the magnetic needle telegraph, as invented and patented by Mr. Henley in conjunction with Mr. Forster. Mr.—now Sir Charles—Bright was the engineer to this company. Mr. Henley manufactured instruments for the company. It was in 1851 that the first success of submarine telegraphy was achieved, and then men's minds became gradually filled with the desire to conquer oceans and to connect nations by telegraphic wires. In 1857 Mr. Henley commenced the manufacture of cables, and although his operations have not equaled those of the Telegraph Construction and Maintenance Company, or the Silvertown Works, or Messrs. Siemens, still he made and laid a good many miles of cable. Short lengths of cable were manufactured for Ceylon, Australia, Spain, etc., and longer lengths for the Indian Government. In the height of this work he employed the three ships, the Africa, the La Plata, and the Cavalier. Besides the large works at Greenwich, Mr. Henley was interested in some profitable Welsh ironworks; but after a season of prosperity there came a time of depression, and Mr. Henley was ruined. He endeavored to resuscitate the telegraph works in 1876, but there did not seem to be life in the concern. In 1880, however, the Henley's Works Company was formed, and Mr. Henley was a director to the time of his death. Of late the attention of the works has been given to ozokeritized core, an insulating material upon which very favorable reports have been given, and which promises well.

The early struggles of Mr. Henley enabled him to thoroughly understand his workmen, of whom, in the time of his greatest activity, he employed about 2,000; he sympathized with them in their trials and difficulties, and they knew it, and were devoted to him. It should have been mentioned earlier in this brief notice that Mr. Henley put up machinery at the Greenwich Works to draw and to galvanize the wire he required. He constructed some of the earliest electric light machines, and, as the records of the Patent Office show, he had in the recent development of the industry devoted considerable attention to the subject and taken out a patent for a machine.—*The Engineer.*

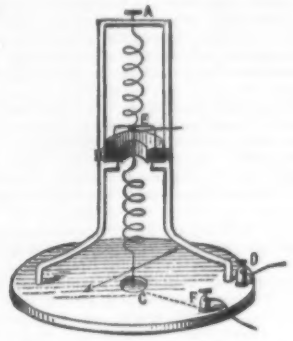
A SIMPLE GALVANOMETER.

THE small instrument shown in the accompanying cut is a very simple galvanometer, which is proof against all magnetic action.

The apparatus is founded upon Joule's law, and is nothing else than a Breguet thermometer, the spiral of which, formed of a fine strip of platinum and zinc, or platinum and iron, is traversed by the current to be measured.

In order to compensate for variations in external temperature, the spiral traversed by the current is suspended through the intermedium of a second spiral, which is identical, but rolled in an opposite direction.

In the figure, A is the point of attachment of the two consecutive spirals; B B, a circular cup filled with mercury; C, a cup full of mercury; and D B E C F, the course of the current.



The law of Joule being expressed by

$$q = Hri^2,$$

we have,

$$dq = 2Hridi,$$

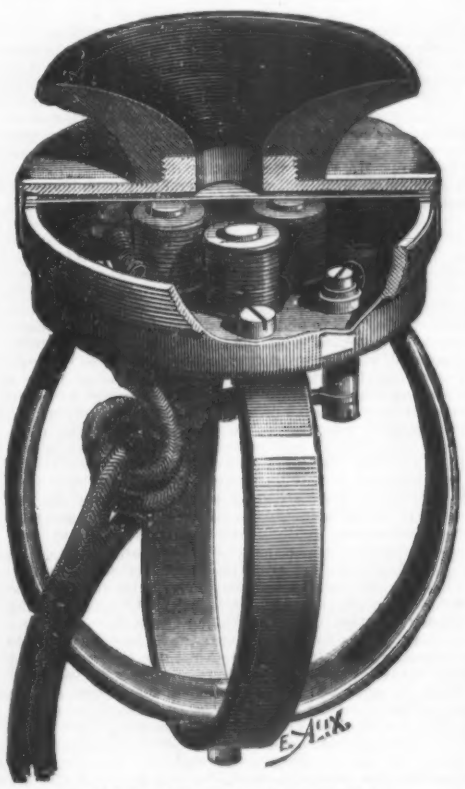
and consequently, we see that the sensitiveness of the instrument increases with the intensity of the current.—*R. Dubois, in La Lumiere Electrique.*

GOLOUBITZKY'S TELEPHONE.

AMONG the telephonic apparatus of which we have not spoken, we may cite that of M. Goloubitzky, which, admirably constructed by M. Lenczewsky, has furnished important results.

Starting from the fact that several telephones placed in the receiving station can simultaneously reproduce speech without there being any perceptible loss of sound in any of them, M. Goloubitzky asked himself the question whether, on condensing all these separate telephones into a single one, we should not have an apparatus that produced more energetic sounds.

Following this line of thought, he felt that several magnets reacting at once upon the same diaphragm might solve the problem; but, for that, it was necessary that the vibrations called forth by them should be concordant, and be unable to give rise to interferences of sonorous waves. He believed,



GOLOUBITZKY'S TELEPHONE.

moreover, that the individual actions of these different magnets, exerting themselves in unison upon the same membrane, ought to aid one another in strengthening the vibration, and that, too, so much the more in proportion as such vibration might be effected over a wider surface, and over a body already set in motion by contiguous actions. It should be recalled that if in a clockwork mechanism the isochronism of its movement be regulated by one of the branches of a tuning fork, and an external cause, even a powerful one, intervene to destroy such isochronism, it will only require the vibration of the other branch to keep it up. The synchronism of M. D'Arlincourt's autographic telegraphs, which is so perfect, is founded upon this principle. In admitting, then, that the resistance of the diaphragm in some of its parts be capable of counteracting the amplitude of the vibration brought about by one of the magnets, a second, third, or fourth magnet, vibrating in the same manner, ought to tend to re-establish and amplify the normal vibration, and such action ought to be the more efficacious if it manifest itself upon a body already set in motion.

As the presence of several magnets before a diaphragm should deviate their polar action from the center, and as, in order to obtain the maximum effect, it is necessary to make them react by their two poles at once, M. Goloubitzky inquired of himself what position around the central point of the diaphragm was most favorable to the development of its vibration, and found himself led to a study of the manner in which a telephone diaphragm vibrates under the influence of the sonorous waves resulting from articulate sounds. He is certain that in order to be in the best condition the magnetic poles should be placed according to the lines of the diaphragm corresponding to the widest parts of the vibration —points upon which electro-magnetic actions can be most efficaciously excited, since they respond to the parts capable of being set in motion under the influence of the vibration of the plate.

M. Goloubitzky's experiments were made at first with the box of a large Gower telephone, which was about 17 centimeters in diameter, and at the bottom of which there was stretched a membrane of parchment. On emitting a sonorous wave through the acoustic tube, the first membrane was set vibrating, and transmitted its motion to the second through the intermedium of the layer of air separating the two. Now, when powder of lycopodium was laid upon this second membrane, it became possible to obtain on its surface the positions of the expansions and contractions of the membrane that corresponded to a given sound. These experiments were pretty delicate ones.

On pronouncing the different letters of the alphabet in the acoustic tube, M. Goloubitzky was enabled to obtain a series of figures which we shall describe, and which, in order to make appreciable, he has referred to a diameter of the membrane divided into seventeen equal parts, each corresponding to one centimeter. "For the letter *a*," says he, "the center of the membrane constitutes a vibrating node in which motion is consequently *nil;* and around this center there extends a circular space 2½ divisions, or 2½ centimeters, wide, which is circumscribed by an annular space, 2 to 3 divisions wide, corresponding to a new node, which is itself surrounded by a new zone of vibration extending up to the edges of the membrane over a width of from 2 to 3 divisions. It results from these figures that beyond 2½ centimeters from the center of the membrane, that is to say, nearly in its median region, there is an annular space which is nearly inert, but which is yet not homogeneous in all its parts, since the lycopodium forms there quite complicated circular and elliptical heaps which announce minimum points of vibration, arranged in an order that is doubtless definite, but that I have not had leisure to study from a scientific standpoint, owing to want of photographs of them. I have been enabled, however, to conclude from these experiments, which are doubtless quite incomplete, that a circular vibrating plate possesses a vibratory note at its center, and that the region nearest this center, at which the vibrations consequently manifest themselves most easily, is found at about two centimeters and a half.

"For the letter *e*, the piles of lycopodium in the space corresponding to the annular node formed two large ellipses in one direction, and two small circles in a perpendicular one. The central circle was accompanied with a dozen small circular heaps arranged symmetrically around it.

"For the letter *o*, the figure was nearly the same as for the letter *e*, at least as to the central part, but the annular node presented more extended ellipsoidal parts, and the small circular parts disappeared when the sound was loud; so that the ring represented then, pretty well, a printed letter O.

"The figure corresponding to the sound *ou*, exhibited around the central spot a series of small circular spots as with the sound *e*, but they were arranged in groups of five at the two extremities of the same diameter, being only two in number on each side according to the perpendicular diameter.

"The sound of the letter *i* gave rise to many small circular spots in the central part, which were surrounded with a compact part, around which were again perceived very small circular spots. For the word *allons*, the vibration was very feeble, and was only two centimeters in width in the center of the disk, and was scarcely visible on the circumference. For the word *attendez*, the figure approached that for the letter *a*. I have, moreover, more than once remarked that for loud sounds the small circular spots elongated and flattened, thus denoting that the nodes increased in dimensions; while, on the contrary, for low tones, they became more convex, while having their diameters reduced. The difficulty of reproducing all these figures without the aid of photography has prevented me from continuing this study, but my experiments have sufficed to settle in my mind what I desired to know relative to the best arrangement to give the parts of the telephone, and to convince me that the inert part of the center of a telephone diaphragm may sometimes reach more than one centimeter in diameter, while the part in which the vibrations are propagated is found in the median part of the disk, at about a third of its diameter. Now, this showed me that I could advantageously place my bobbins away from the center of the diaphragm."

In accordance with these considerations, M. Goloubitzky arranged in front of his diaphragms, and according to the annular region corresponding to the widest part of their vibration, the poles of several iron horseshoe magnets crossing one another. These, moreover, he arranged in different manners with respect to each other. On one occasion he employed four, whose poles were arranged around the center of the diaphragm according to the sides of a square. Again, he employed only two, which were crossed at right angles, like that which we represent in the accompanying cut; and then the poles formed the four angles of a perfect square. This was found to be the most economical arrangement, and is the one that he seems to have adopted by preference. The respective arrangement of the poles, one with regard to the other, has also been an object of study on Goloubitzky's part. That in which a south pole is placed between two north ones, and one north one between two south ones, has seemed to him to give the best results. To carry out such an arrangement, however, it became necessary to magnetize the magnets before mounting them. But it was found that it was never possible to adjust them as perfectly with respect to the diaphragm as it was when they were magnetized after mounting. In this last mode of construction the arrangement in which two north and two south poles were placed alongside of each other presented some advantages, since it permitted of a more easy magnetization, it being only necessary then to rest them two by two upon each of the poles of the magnetizing electro-magnet, and to hold them there for about five minutes. There was nothing to take apart, nothing to adjust, and the regulation of the diaphragm was, moreover, effected easily; for, in separating it from the cylindrical telephone box by a small copper ring placed on the edges, it was possible, by tightening more or less the cover carrying the mouthpiece, to give sufficient stiffness to the diaphragm to properly separate the four magnetic poles. This was denoted by the hollow sound that was heard on striking a few blows on the diaphragm through the aperture of the mouthpiece. The bobbins of the electro-magnets were connected at first in such a way as to correspond to the two different poles of the same magnet, and the two pairs of bobbins were afterward united in such a way that the current passed from one into the other in tension.

M. Goloubitzky asserts that he has made some experiments in order to ascertain the power of his apparatus, and has found that it exceeds that of the best telephones known up to the present time in the proportion of 120 to 40. We leave the responsibility of such an assertion to him, limiting ourselves to narrating the manner in which he performed his comparative experiments.

He employed as transmitter a Gower-Bell microphone, to whose disk he applied a metallic wire, fixed to the upper part of a metronome. The circuit of this transmitter terminated in a commutator capable of putting the microphone successively in connection with several telephones of different kinds, provided with ear trumpets. Then he successively removed his ear to a distance from these trumpets until the sounds of the metronome, reproduced by the different telephones, were no longer perceptible. Now, on performing the experiment, he found that with some it was necessary to remove the ear 20 centimeters, with others, 40, and, finally, with his own, 120. Not having verified this assertion, we shall say nothing more about an experiment that everybody may repeat.

As may be seen, M. Goloubitzky's apparatus is founded upon reasoning, and, from this point of view, it has merited our dwelling over it somewhat.—*La Lumiere Electrique.*

KOTYRA'S TELEPHONE.

MR. G. BELL ascertained at the very start that those telephones in which the magnet acts upon the vibrating diaphragm through its two poles at once give much intenser sounds; and the style called the "square model" has always been considered as the *ne plus ultra* of this kind. But, since such apparatus are not portable; and are much dearer than others, they have not come into so general use as the ordinary small types having a straight magnet.

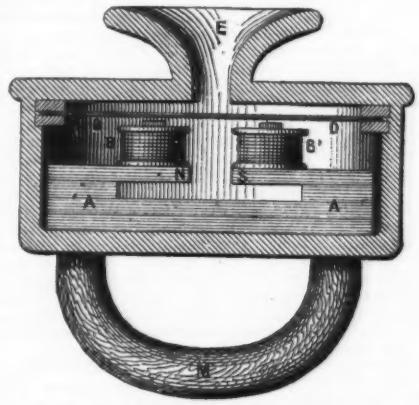


FIG. 1.—SECTION OF TRANSMITTER.

Nevertheless, Messrs. Phelps, Gray, Siemens, Gower, and Ader have endeavored to render horseshoe magnet telephones portable, and have produced some well known models, that have given good results. However, the manufacture of horseshoe magnets being necessarily expensive and their adjustment difficult, by reason of the pieces getting out of shape in tempering, their price has always remained relatively high, and it was to be desired that a means should be found of rendering the construction of such telephonic systems sufficiently simple to permit them to be offered at the price of telephones with straight magnets. Such a problem has been solved very well by M. Kotyra.

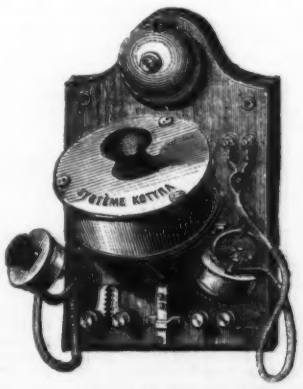


FIG. 2.—KOTYRA'S TELEPHONE.

In this inventor's system, the horseshoe magnet consists of a union of small thin strips of tempered steel of different lengths, cut out of the same bar and connected so as to form an electro. Such a mode of construction is easy; for, considering that two of these strips are longer than the others, and are superposed (as seen at A A, Fig. 1) so as to form the back of the magnet, it is only necessary, in order to form the branches and polar extremities, to superpose at the two ends a short strip of steel or iron, to which is affixed another strip of steel, N S, whose length is a little less than half that of the back strips. To the two extremities of these pieces, N S, and a few millimeters apart, are riveted two cores, which, surrounded by two bobbins, B B', complete an electro-magnetic system, in which no piece has to be forged, and which being magnetized strip by strip, is capable of furnishing a

more energetic and durable magnetization than is done by those systems having a bulky magnet made in a single piece. The rest of the system may be constructed as in the ordinary Bell telephone, and have any external form whatever.

M. Kotyra has likewise simplified the mode of mounting of the apparatus by inclosing the commutator designed to put the line in connection with the call bell or telephone in the very box with the telephone transmitter.

This system of telephone is naturally capable of working with or without a pile. Up to the present, M. Kotyra has preferred to use as transmitter a telephone of his own system, which he has made of larger dimensions, and which he has arranged so that it will present itself to the voice at a certain angle, as in the desk transmitter now so much used.

The apparatus thus appears as shown in Fig. 2, in which the receivers, hanging from hooks projecting from the circular box of the transmitter, act upon the commutator in the same manner as in other systems. The curved handles seen at the posterior part of the telephones are of wood, and have nothing in common with those in the Ader telephones, which are formed by the electro-magnets themselves.

M. Kotyra's telephones have been tried with success on the line of the North. It has been found possible to correspond with them from Paris to Creil, and it appears that the small model may be applied on lines of six kilometers. The inventor has, moreover, modified their arrangement slightly in order to construct them of smaller size while preserving to them all their force. On another hand, he has constructed a more powerful model capable of making an impression upon the two ears at once.—*La Lumiere Electrique.*

ELECTRIC LIGHTING OF THE BRUSSELS TELEGRAPH OFFICE.

THE lighting of the telegraph office at the Brussels North Station is now being done by electricity, and M. J. Dumont, engineer to the administration of telegraphs, some time ago published a report on this installation that contains some very interesting technical details.

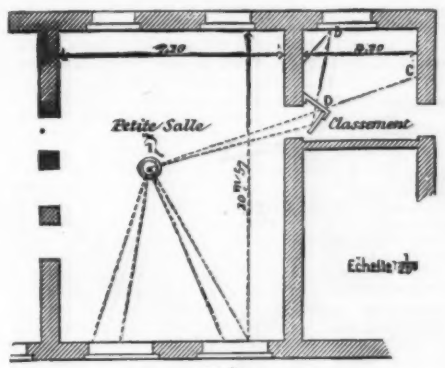


FIG. 1.

The lighting is done by the aid of regulators on the Jaspar system, which are installed, according to a process peculiar to this constructor, so as to direct their rays toward the ceiling in order to obtain a diffused and soft light.

These regulators have been put in at the Brussels office. As well known, these apparatus are holophotic—that is to say, they do not permit of a division of the current, and each requires a generating machine. For this reason, there have been installed three Gramme machines run by a gas motor.

An endeavor was made at first to arrange the regulators so that the light should, unaided, project itself upon the ceiling. To this end, the positive carbon, which, as well known, is the most luminous, was placed below. But, with this arrangement, the regulators did not work so well, and it was therefore decided to place the positive carbon above, and provide the apparatus with suitable reflectors. One large hall has two reflectors, and another and smaller one is lighted by the third. It remained to make provision for

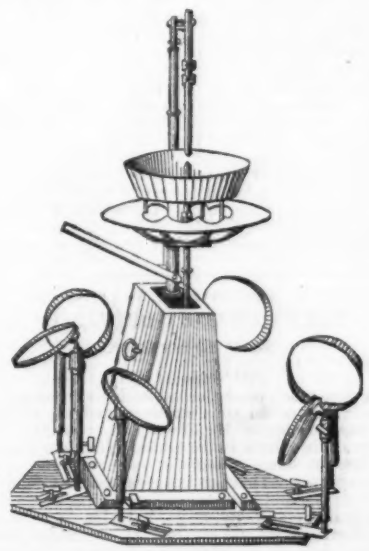


FIG. 2.

a small apartment in which the telegrams are classified. By a process already made use of by M. Jaspar, a portion of the light is borrowed from the last-named lamp. The halls in question present in plan the arrangement shown in Fig. 1. The electric lamp numbered one, and placed in the smaller hall, is provided with a system of lenses, whose general arrangement is exhibited in Fig. 2. As may be seen, the point at which the arc is formed carries a horizontal reflector and a conical one, nickel-plated internally, for the purposes of shielding the eyes of spectators from the direct glare of the arc and of throwing the rays toward the ceiling. The lenses are fixed to the base of the apparatus by means of movable supports, which permit of their being given the direction necessary to send their luminous fascicle to the point at which it is to be utilized. The plan shows that two fascicles are directed to the small classifying room, one of them being reflected by a mirror, at D, to a white curtain, B, and the other going directly to C.

It has been found by direct measurements that each of the generating machines absorbs, on an average, a power of 2½ horses.

The measurements of the resistances of the circuit and that of the parts of the lamps and the carbons, and the measurements of the differences of potential at the terminals of the machine and at those of the lamp, have given the following results:

Resistance of the machine, 0·89 ohm; of the conducting wires, 0·48 ohm; of the solenoid of the lamp, 0·086 ohm; of the carbons together, 0·327 ohm; difference of potential at the machine, 57 volts; at the lamp, 51 volts; work absorbed by the machine, 2·5 H.P.; work developed in the entire circuit, 1·241 H.P., or 49·64 p.c.; work developed in the lamp, 1·095 H.P., or 43·8 p.c.; work developed in the arc, 0·958 H.P., or 38·32 p.c.

It should be remarked that the resistance of the machine was measured cold. While working, it would be perceptibly higher, by increase of the temperature. These figures, then, are only approximate. The same must be said of the luminous measurements. It is well known, to begin with, how hazardous such measurements are of themselves in all cases, by reason of the uncertainty of standards and of the differences in color. In the present case, the measurement has only been taken in the plane passing through the arc perpendicularly to the line of the carbons. As well known, this is not the maximum intensity, the latter being furnished by a ray which makes a certain angle with such plane.

The report admits that the mean intensity is double that that has been measured in the plane indicated—a somewhat vague approximation, since that depends much on the length of the arc and its mode of working. Moreover, as will be seen, there are many other causes of error. However

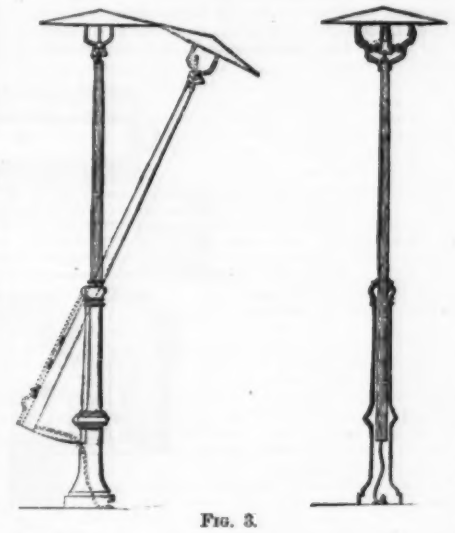


FIG. 3.

this may be, the report admits that the regulators give, on an average, a light of 1,670 candles.

As for expenses, the data are naturally more precise. The comparison with gas is interesting. It appears that the old way of lighting, with seventy gas burners, cost, including everything, 1·86 francs per hour; while the new mode of lighting with electricity costs 3·82 francs per hour. But such a comparison should be placed side by side with a comparison of the lights, which are very unequal, the electric light being much more intense. M. Dumont's report makes this comparison simply by adding the sum of the light produced by the gas and that which the regulators give according to the above measurement. Now, there are many elements neglected here, for the gas burners were not raised to the level now occupied by the regulators; and, on another hand, the latter do not send their light directly, for it is reflected and then diffused, thus considerably modifying the result. We do not cite, then, the figures given by the report, although we are inclined to think with it that, on the whole, with equal light, the electric lighting is rather lower as regards price.

At all events, what is certain is that electricity has permitted of being done what otherwise could not have been. The lighting of the halls was insufficient, while, at the same time, the heat was insupportable. The light has been increased, and the temperature has been lowered—a result that would have been impossible with gas.

The success of this lighting has, moreover, led to its extension; for three of the regulators have been put up in the Place des Nations, in front of the railway station, where the telegraph office is located. These regulators are placed on swinging posts analogous to those that M. Jaspar arranged for his exhibit at Paris in 1881 (Fig. 3). The two parts of the post are so balanced as to require as little power as possible to maneuver it. The lamp is carried by small pivots, so as to remain vertical during the motion. These three regulators replace twenty ordinary street gas lamps and two Sugg burners. The result has been found good. The price for gas was 1·02 francs per hour; for electricity, it is 2·55. A comparison, as regards intensity, has not been made.—*La Lumiere Electrique.*

SIMPLE DIP CIRCLE.

A DIPPING needle suitable for the requirements of schools and science classes has long been a desideratum, there having been no instrument obtainable hitherto which would, at a moderate cost, afford results of sufficient accuracy. Between the mere needle suspended in a simple stirrup of brass and the delicate and complicated dip-circles of standard pattern there has been no intermediate form of instrument. This deficiency, has, however, been remedied by Mr. Walter Goolden, M.A., Science Master in Tonbridge School, who, in conjunction with Mr. C. Casella, has designed the form of portable dip-circle depicted in the figure, which possesses several novel points. The needle, which is 3½ inches in length, is poised upon an accurate axis working in sapphire centers, and magnetized once for all. In order to insure the coincidence of the center of gravity with the center of suspension, two very light adjustable counterpoises are fixed to the needle, one of them being capable of being moved parallel to the length of the needle, the other lying at right angles to the first and adjustable in a direction to the right or to the left. The metallic circle within which the needle revolves is graduated on both faces, and is inclosed within an air-tight case. The instrument turns upon a vertical support above a solid metal plate standing on three leveling screws. A small loose level, which can be placed upon this leveling-plate, accompanies the instrument. The main novelty in Mr. Goolden's instrument consists, however, in the arrangements by which the angle of dip may be determined without having either a horizontal graduation or a horizontal compass upon the needle apparatus. It will be seen by reference to the figure that the vertical axis of the instrument is furnished with a spring-arm, which can be clamped to it by turning a screw, and that there are four metal studs affixed to the stand at equal distances apart, into any one of which the pin at the end of the spring arm can be pressed down. These arrangements serve to facilitate the following adjustments. Having leveled the instrument, the spring-arm must be unclamped and the pin at the end of it pressed down into the conical hole in one of the studs. While this is so held with one hand, the vertical circle is turned upon its axis with the other hand *until the needle points directly vertically downward to* 90°. In this position, which is of course exactly magnetically east and west, the vertical circle is clamped by a turn of the screw. The position is verified by turning the whole circle and spring-arm together upon the axis until the pin meets the opposite stud, when the needle will again point vertically downward. The east-and-west position being thus verified, it is clear that the magnetic meridian will lie in a plane at right angles to this. Hence the next process is to turn the circle round and press the pin into one of the two studs which lie at right angles to the pair already employed. The position of

GOOLDEN'S SIMPLE DIP-CIRCLE.

the needle in the circle is then read off. The circle is once more turned through a complete semicircle, the pin pressed into the opposite stud, and another reading is taken, the mean of these two being accepted as the true angle of dip. It will be seen that the usual elaborate processes of eliminating possible errors by reversing the needle-axis upon its bearings and reversing the magnetism of the needle itself are not attempted. Everything will therefore depend upon the accuracy of the adjustments of the instrument before it leaves the maker's hands. As it is, it is claimed that the readings are correct to within ten minutes of arc.—*Nature.*

RADIATION OF COLD.

To the Editor of the Scientific American:

In your SUPPLEMENT of January 20, an entire column of your valuable space is devoted to an attempt to controvert the accepted scientific explanation of the apparent radiation of cold from bodies having comparatively a low temperature. While there is no cogency whatever in the reasoning of your correspondent, the mere circumstance that it has found a place in your publication will give it a certain weight with those who are incapable of answering it.

The writer propounds the paradoxical theory that cold radiations cause the column of mercury in a thermometer to fall, *because they are really warm.* He does not himself make this bold statement of his hypothesis, which is in itself a *reductio ad absurdum*, but his language, if it means anything, can mean nothing else. I quote his *ipissima verba:* "Now, that these same heat rays cause the thermometer to rise from 20° Fahr. is a demonstration that they alone cause the thermometer to fall in the quoted experiment," where cold rays from a freezing mixture are converged by a concave mirror upon a thermometer placed in its focus.

By parallel reasoning, a pint of water at 60° Fahr., poured into a gallon of water at 32°, raises its temperature because it is relatively warm; if poured into a gallon of water at 212°, it cools it for the same reason, viz., because it is absolutely warm!

For the sake of those, however, who may have a lingering faith that the paradox covers a truth, I reason the matter thus:

A thermometer makes apparent to the eye and actually measures the molecular motion of a certain portion of mercury. If molecular motion is added, the mercury expands, rising on the scale; if molecular motion is lost, it contracts, and the thermometer falls. Now, it is clear that the relatively cold thermal radiations from a freezing mixture do not communicate molecular motion to the mercury, because the fall of the mercurial column proves that molecular motion has been lost and not gained. The phenomenon is, however, perfectly explained by the hypothesis which the writer attempts to confute. The mercury is communicating its molecular motion to surrounding objects in the form of radiated heat. Its particles do not come to rest simply because the molecular motion of surrounding objects is in turn communicated to it in similar radiations. Now, let surrounding objects be colder than the thermometer; the motion lost will not be compensated by what is received, and the thermometer will fall.

The only real argument advanced by the writer was based

on an erroneous assumption that heat is lost by a body only when it is radiated to one having a lower temperature. Hence, he argues that, if the respective positions of the thermometer and the freezing mixture in the experiment be exchanged, so that the thermometer occupies the focus nearer the mirror, a larger proportion of its heat being communicated to the ice than when in the usual position, its temperature ought to fall more rapidly, while such is not the observed fact The truth is, that the thermometer loses heat constantly by radiation without reference to the proximity of cold or warm bodies; the heat which goes from it to the sun is as certainly lost to it as that radiated toward the freezing mixture. But among the radiations by which this lost heat is to be restored, there are twenty-five times as many of these emanating from the freezing mixture in the one position as in the other. The temperature of the mercury in either case will continue to fall until equilibrium is established.

At bottom, the writer's difficulty appears to consist in confounding the sensations of heat and cold with the well understood physical phenomena producing them.

A. B. LYONS, M.D.

Detroit, Mich., January 24, 1888.

ZINC—ITS USES AND MANUFACTURE.

ZINC is a rather hard, bluish white metal, tough and not easily broken by blows of the hammer in its ordinary state at common temperatures, but when heated to a point approaching that of fusion it becomes brittle. At temperatures between 210° and 300° it is ductile and malleable, and may be rolled into thin sheets and drawn into moderately fine wire, which, however, possesses but little tenacity. It preserves its malleability after rolling. Sheet zinc is largely used as a covering for roofs, and for other purposes, particularly for cornices, and it is also used for coating iron, which is then commonly said to be galvanized. For this purpose the iron is dipped into dilute sulphuric acid to remove scale, and then plunged into a bath of molten zinc, covered with sal ammoniac. Zinc fuses at a temperature of 773° F. Combined with copper, it forms brass; with the addition of tin and other metals, various similar alloys are formed, some of which are distinguished by specific names. The prepared oxide is extensively used as a pigment, and the sulphate is the white vitriol of commerce. It is not found native. Its principal ores are the red oxide; the carbonate or calamine; the sulphide or blende, the dark varieties of which are termed black-jack by the English miners; and the silicate, which is usually found associated with the carbonate. The metal itself was unknown to the Greeks, Romans, and Arabians, and in fact in Europe previous to about the middle of the sixteenth century, though it is said to have been used in India and China from an early period.

It is produced in England, France, Belgium, Germany, and the United States; principally in New Jersey and Pennsylvania in the latter country.

The fact that certain ores produced a yellow copper was early known, and the product was highly esteemed; but it was not understood that it was a true alloy, nor was zinc obtained distinctly. This was partly owing to the fact that zinc vaporizes at a certain heat, and the sublimed portions which adhered to the sides of the furnace had no appearance of metal. Mines yielding this gold colored metal were highly esteemed, and when exhausted the fact was lamented; but in the course of time it was discovered that the addition of a certain stone (calamine) to copper, when melting, gave it the desired yellow color. This earth was used for this specific purpose, but it was long ere the truth was elicited that calamine was a metallic ore, and yielded its base to form an alloy with copper.

Aristotle, Strabo, and various other writers refer to an earth which conferred a yellow color on copper. Brass was considered a more valuable kind of copper.

Ambrosius, Bishop of Milan in the fourth century, Promasius, Bishop of Adrumetum, in Africa, in the sixth century, and Isidore, Bishop of Seville in the seventh century, mention an addition by which copper acquired a gold color. This was, undoubtedly, calamine.

Albertus Magnus (1205–1280) speaks of calamine as a semi-metal.

The furnace calamine, or sublimated zinc, with which the furnaces and chimneys were lined where zinc-yielding ores were smelted, was thrown aside as useless until the middle of the sixteenth century. It had a place in the pharmacopœia, but this use required but a small portion of the quantity produced.

Erasmus Ebener, who died in 1577, used the furnace calamine instead of native calamine in making brass. This was introduced at Rammelsberg about 1557. Its use in this connection had been previously described by Albertus Magnus.

White vitriol, the sulphate of zinc, was long prepared, used, and employed before it was known that it was a salt of zinc. It is said to have been first made by Duke Julius, at Rammelsberg, in 1570. Its application to make an eye water is its first recorded use.

In the preparation of metallic zinc, as practiced in this country, by what is known as the Belgian method, the ore, having been broken and calcined, is mixed with 33 per cent. of crushed coal, and the mass is distributed in charges of 27 pounds to retorts, of which there are fifty-six in each furnace, arranged in tiers. The orifices of the retorts are cemented in conical tubes of fireclay, projecting 18 inches beyond the sides of the furnace, and the interspaces sealed with fireclay. The furnace is then fired up until a heat of 2,160° F.—the vaporizing point of zinc—is attained. The carbon combines with the oxygen in the ore, and the metallic vapor is condensed into the liquid form by the projecting tubes, which have a temperature below that of the vaporizing point of the metal.

At intervals the molten metal is withdrawn from the retorts, by means of iron hooks or scrapers, and is received in large ladles, from which it is poured into iron moulds, forming slabs weighing 30 pounds each. The gases issuing from the orifices in the condensers during the process burn with the most vivid flames and varied colors. While still hot, the slabs of zinc are taken from the moulds and rolled into rough, thick plates, 10 x 18 inches; from nine to twelve of these are placed in an iron box, and, the boxes being placed in a furnace, the pack of plates is removed from the furnace, and the whole rolled out together, each plate forming a sheet, when trimmed, 7 feet long by 3 feet wide.

In making oxide of zinc, or zinc white, the carbonate and silicate of zinc, as they come from the mine, are crushed, mixed with 33 per cent. of coal, and heated in large firebrick furnaces provided with an air blast, the oxygen from which combines with the metallic vapor as fast as it is liberated. The oxide thus formed is conveyed by a blast into a shaft, whence the white flocculent vapor, which is contaminated with various impurities, is driven by blowers through a series of chambers connected by pipes. The impurities are successively deposited, the purest vapors passing through the pipes and being finally condensed, as an impalpable white powder, in muslin bags attached to the pipes.

It has been proposed to employ zinc for extracting gold from auriferous rocks. The pulverized rock is gradually introduced into a bath of molten zinc, which combines with the precious metal, while the refuse rises to the top and can be skimmed off. The gold may be subsequently separated by distilling the alloy, the zinc passing over and leaving the precious metal behind.

The following is the thickness and weight of zinc sheets per square foot: 0·0311 inch, 10 oz.; 0·0457 inch, 12 oz.; 0·0534 inch, 14 oz.; 0·0611 inch, 16 oz.; 0·0686 inch, 18 oz.; and 0·0761 inch, 20 oz.—*Glassware Reporter.*

MERTON'S APPARATUS FOR REFINING ZINC.

THE process of refining zinc, devised by M. Merton, of Frankfort (German patent, No. 17,521), consists in melting the crude product at a red heat in a reverberatory furnace, and in first removing the mixed lead by ordinary means. Sulphur is afterward introduced into the molten metal by means of an iron tube perforated with holes at its base, and which is given a backward and forward motion. In this way, the metals that contaminate the zinc separate in the state of sulphides and may be ladled off. The zinc is then distilled in retorts, P (Figs. 1 and 2), heated by the gases brought from the generator, G, by the flues, *i*. The air that is necessary is, in the first place, heated in the flues, *o*, and the gases derived from combustion flow to the chimney through the conduits, *n* and *s*. A condensing pipe, *a*, provided with a cooler, leads to the reservoir, B, in which there is a partition, *x*, that carries in front, near the orifice of the pipe, *a*, a screen for holding back the drops of liquid zinc that might possibly leave the pipe, *a*, and fall toward the bottom of the reservoir. In order that it may be cooled from the exterior, this partition is made double. The volatile impurities can thus be deposited upon the upper cool surface, from whence they may be removed through an aperture. The liquid zinc is allowed to flow out through an aperture in the bottom of the reservoir, B.

The zinc, purified in part by the sulphur, is thrown into the retorts, through the opening, A, in sufficient quantity to half fill them. Into the reservoir, B, there is inserted a pipe, *v*, provided in front with a mica window, in such a way that it shall cover the condensing pipe and close the reservoir, B. This pipe, *v*, is designed for removing the impurities which first distill off, such as cadmium, antimony, mercury, sulphur, etc. Zinc dust and zinc oxide afterward deposit upon the hollow partition, *x*, and are removed through the aperture located above it. As soon as the pipe, *a*, is brought to a red heat, it no longer distills anything but zinc, and the condensing pipe must be cooled. The tubes, *r*, serve for prolonging the passage traversed by the vapors.

The zinc collected in the reservoir, B, flows into an ingot mould, which is shown in Fig. 3, and the principal part of which, provided with a mouth, I, and skimmer, *g*, dips into a reservoir, V, full of water.—*Dingler's Polytechnisches Journal.*

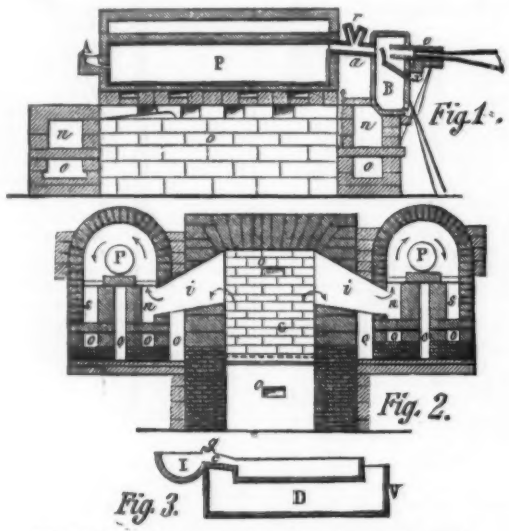


Fig. 1.

Fig. 2.

Fig. 3.

MERTON'S APPARATUS FOR REFINING ZINC.

MANUFACTURE OF SILVERWARE.

THE earlier silversmiths of the United States made their dinner and tea sets, punch bowls, goblets, etc., by hammering the various dishes from flat sheets of solid metal, shaping them upon iron forms called "stakes." The process of building up round and oval dishes is still the same in principle, only that the hammer is no longer used, and the iron stake is thrown aside for a block of wood. Take a sugar bowl for example. A perfectly round disk is cut from a flat sheet of solid silver, weighed, and turned over to a workman, to whom it is charged on the books. The workman has a block, made in pieces like a hat block, so that, if a certain key be removed, it will fall apart. The block is put together and keyed, and put into a lathe touching the flat disk of silver. The block and the silver disk are then made to revolve at great speed. A smooth steel tool is pressed against the disk; and the malleable metal is made to bend down upon the block little by little, and gradually inclose it, forming the body of a perfectly symmetrical and smooth sugar bowl, without joint or flaw. The top and bottom are properly trimmed with a sharp tool, and the bowl taken from the latter. It would be impossible now to get the wooden block out of the silver bowl, were it not that the block is made in pieces. The workman loosens the key which binds the block together, and shakes the pieces out of the narrow mouth of the sugar bowl. The bottom of the sugar bowl is shaped upon an appropriate block by the same process, which is called "spinning up." The handles are cast, and the differents parts fastened together by soldering under a blow pipe. This is in principle the manner in which all round and oval dishes, presentation pieces, goblets, etc., are made from solid silver. For convenience the bodies are sometimes made in several parts, so as to permit the insertion at different places of a flat strip of decorated metal which has been rolled in a machine, and they are then subsequently assembled by the silversmith proper, and united by soldering. The soldering is so perfectly done that the finished article is in fact one piece of solid work—as much so as though it had been cast. All scraps are carefully collected and weighed, and credited to the workman to whom they were previously charged. Large objects, like punch bowls, and all others of irregular shape, are hammered out by hand from flat sheets of metal and put together by soldering. Projecting ornaments, like monograms, flowers, handles, etc., are frequently cast solid, and put upon the piece in the usual way; but by far the greater part of the decoration is done by chasing and engraving. The pattern is drawn in black and white upon sheets of paper. The workman goes all over the inside of the goblet, teapot, or other piece, whatever it may be, with a delicate hammer, and beats down the metal, so as to raise the large leaves, flowers, scrolls, etc., of the pattern, into relief on the outside of the piece. The dish is then filled with melted pitch and resin, which is allowed to solidify and form a backing, in order that it may not lose its symmetrical shape in the subsequent processes. The workman next goes carefully over the whole of the surface outside which is to be decorated, and fashions it by indenting and beating down the metal, with little chisels and a hammer, so as to leave a clear, sharp-cut pattern raised in high relief upon the beaten down background. The pitch is then removed by melting, and the dish goes on to be smoothed, burnished frosted, satin finished, or gilded, as the case may be, for the store. The ornamentation of flat surfaces is sometimes done by etching. Spoons and forks are made by rolling in a machine, the pattern of the fork or spoon being engraved on the surface of the rollers. The edges of surplus metal are removed by clipping and filing, and the article receives its final shape under a die. The handles of nut picks and knives, when hollow, are stamped in a die in halves and united by soldering. In the solid silver shops great care is exercised to prevent the waste of metal. The waste in polishing, clipping, filing, etc., is enormous, amounting in some large establishments to from four hundred to six hundred ounces a week in the process of polishing with leather and cotton alone. All the refuse of the shops, the grease, the dirt of the floor, the water in which the silver is washed, etc., is carefully saved and sent to the furnace for the extraction of the metal. With all the precautions that intelligence can suggest, it is still found that five per cent. of the metal weighed out to the workmen is never recovered.

In the factories of plated ware a large part of the work is done by stamps, dies, and presses; and more of the ware is cast than in solid silver shops. The metal forming the basis of the pieces is usually German silver (an alloy of copper, nickel, and zinc), Britannia, white metal, and aluminum. Brass and copper are sometimes used for very cheap work.

Within the last ten years the United States have made a great advance in the beauty and originality of styles of silverware. Some factories make a hundred different patterns of tea sets. One company make nearly three hundred varieties of spoons. The New York city factories produce designs which are not surpassed anywhere in Europe.

The taste for solid silver is also increasing. There already begins to be visible in centers of wealth and fashion a little of that pride in the family plate which exists so strongly in some European countries, and which argues well for the future of the industry in the United States.—*Glassware Reporter.*

[Continued from SUPPLEMENT, No. 370, page 5898.]

THE UTILIZATION OF WASTE.*

By P. L. SIMMONDS.

MINERAL WASTE.

I MUST now touch upon the utilization of mineral waste.

The utilizing of tin plate cuttings, and the recovery of the tin, has become an important and profitable industry. The make of tin plates in the United Kingdom amounts to about 2,500 000 boxes of one cwt. or more each, of which half are exported. The vast heaps of scrap tin found about tin ware works, and the quantities of refuse tin cans that form such an item of city waste, have long been made the subject of experiment, to separate the tin coating from the sheet iron. It is not my object here to go into the mechanical and chemical processes employed in various industries to recover and utilize waste. I simply desire to point out the results which have been attained. In the manufacture of tin ware, it is said 6 per cent. of the whole of the plates employed disappears in the form of scrap. Birmingham produces thirty tons per week. Mr. Beck, of that town, is said to have made a profit for many years of £100 a week by taking off the tin from the scrap by solution and precipitation. A very fair trade is done by parties who go about the tin works buying up the tin dust. They even go to France

* A paper recently read before the Society of Arts, London.

and other countries, and ship it to England to be reduced. This so-called tin dust is really the scum of the tin pot, and, as it is mixed with grease, it is black. It contains a considerable quantity of metal, which is reduced by ignition and flux. An engineering paper states that the waste of tinned iron, used for all kinds of purposes, but especially for sauce pans, kettles, button making, etc., was formerly large, but a method is now employed by which the tin can be recovered from the waste, simply by the action of dilute sulphuric acid. Tin, to the extent of from 5 to 15 per cent., and worth about £97 per ton, with a large amount of sulphate of iron, is thus procured, giving a large profit on the operation. The quantity of boxes required for preserving fish, meat, fruit, vegetables, and other food articles is enormous. Australia, France, and South America use a great many; the Dominion of Canada and the United States still larger quantities; Nova Scotia and New Brunswick require annually five million pound boxes for preserving lobsters; British Columbia twenty million for salmon; Baltimore consumes forty-five million, which are nearly all for fruit and vegetables; Portland, ten million. As tin is an expensive metal, any recovery of it from tin parings and scrap iron is of importance.

Within the last quarter of a century, that formerly neglected mineral, pyrites, has been turned to useful purposes, to supply our manufacturers with the important material, sulphur. Our imports of cupreous iron pyrites (chiefly from Spain and Portugal) now exceed 540,000 tons annually, and this furnishes, on an average, 130,000 tons of sulphur. The value of the sulphuric acid made in Great Britain is stated to exceed £5,000,000. In the United States, about 50,000 tons of pyrites are also used; in Germany, 74,000 tons; and it is now also utilized in other countries. Instead of throwing away the roasted pyrites, as was formerly the case, when the sulphuric acid maker has extracted the most of the sulphur, he hands over the burnt ore to the copper extractor, who not only separates the copper it contains, but, at the same time, so perfectly removes the sulphur that the residue, consisting chiefly of peroxide of iron, is suitable for, and is now largely used in various iron making processes. Besides this, the pyrites in its original condition contains from ½ oz. to 1 oz. of silver per ton, and chemical processes have been devised by which this small quantity can be separated at a profit; for at one of the works on the Tyne more than 16,000 oz. of silver are extracted annually.

In wire-making factories, the dilute sulphuric acid, formerly used to clean the wire, was allowed to run into the sewer, when it had become so charged with the iron scale as to cease to "bite," and large quantities of refuse wire were employed only to fit up hollows in grading, or thrown into a heap. All this waste material is now, however, converted into articles of commercial value. The processes are simple, and comparatively inexpensive. The diluted acid, charged with iron, is heated in lead-lined tanks, by means of steam passing through coils of copper pipe, the waste wire being thrown in. In about five days, the acid, under the influence of heat, has taken up a large proportion of iron, and become liquid sulphate of iron, which is then evaporated until it readily deposits the well-known crystals known in commerce as copperas. In one American works, three tons of this solid sulphate are made per day from about twelve tons of the waste acid. The remaining liquid is returned to the receiving tank, to be mixed with more of the waste acid and refuse wire, and so the work goes on in a continuous round. Even the waste of this product from waste is utilized. The settlings of the boiling tank—oxide of iron—together with the waste copperas, an alkali, and an inexpensive substance to give "body," are roasted, ground, and metamorphosed into a pigment quite equal to imported Venetian red. Of this some factories make about 500 barrels per month.

But not only in the inferior metals is waste now prevented, for increased attention is given to the collection of gold formerly lost. Immense heaps of refuse, or "tailings," as they are technically termed, accumulate where mining operations are carried on. The sludge which is emptied from the puddling mills in Australia contains a considerable quantity of fine gold. Much of this is now recovered, and the yield of gold from these exceeds three cwt. per ton. The right to wash these tailings is often sold to the Chinese, who are always well satisfied with the result of their labors.

The quantity of gold used in the arts, in interior and exterior decorations, in photography, electro-gilding, water-gilding, the ornamentation of china, etc., is very large, and the greater part is practically lost. Jewellers' sweepings from the floors of the workshops are carefully collected, and even the clothes of the workmen are generally saved, and sent to the refiner. After a large gold coinage at the Royal Mint, there is always a great deficiency in waste and sweep. The sweep is composed of cinders or dust from the forge, the sweepings of the workshops, broken crucibles, the dross which adheres to the ingots of metal after fusion, and of every waste which can possibly contain minute particles of the metal. This is generally sold. The silver and gold from photographers' waste is also now carefully collected, and forms a considerable item of economy. A method of utilizing the waste of gold-leaf, used in printing and the arts, is by converting it into what is called fleece gold. The composition is used like the ordinary bronze, except that rather more copal is mixed with it. It is used for all fancy papers for which gold leaf and bronze have hitherto been used.

Mr. Chance, last session, in a paper read before the society, gave a record of recent results in the recovery of sulphur from alkali waste.

The waste of the glass furnaces, such as pieces of broken glass, flaw-glass, the hearth droppings, and the glass remaining adherent to the blower's pipe, is utilized again, serving a purpose in the manufacture of glass similar to rags in paper-making. Agate glass is made by melting waste pieces of colored glass. 1,000 to 2,000 tons of cullet, or broken glass, is collected in the metropolis alone, and sold to the few city glass works, to be remelted. Broken bottles are now collected and utilized. Thousands of tons of these are broken every year in London alone. Broken "wines" and broken "sodas" are converted to many useful purposes, the latter especially. The broken bottles are utilized for the manufacture of cheap jewelry, chimney ornaments, and inferior household glass for the manufacturing districts. They are also used for the manufacture of emery powder, glass paper, etc. Some idea of the number of "sodas" broken in the processes of filling, corking, cleaning, and distributing may be gathered from the circumstance that one great mineral water manufacturer in London sold last year 100 tons. The value of the "metal," as it is styled, is somewhere about 10s. per ton, but it varies according to the demand. When the market for "fancy goods" is active, broken bottles command a better price. A revival of trade sets this particular industry in motion along with others, and broken bottles are enhanced in value. In fact, broken glass and broken pottery serve many purposes, though it is only lately that economic science has learned how to turn them to account.

The chairman of the council, in his opening address, stated that the annual value of the by-products of gas-making—tar, coke, and ammonia—already exceeds, by nearly £3,000,000, that of the coal consumed in our gas works. There are many, like myself, who can doubtless remember the difficulty the gas works had in former times of getting rid of their tar, and walls and fences were then freely coated with it. The French were the first to make the utilizing the waste gases of the coke ovens a commercial success, and now the English and the Germans find that they can gather both the tar and the ammonia water in the gases from coking-coal. It was stated recently in *Engineering*, that at the Gartsherrie Works of the Messrs. Baird, the gases that were wasted in the production of iron have been made to do double duty. Not only have they been utilized, as is common, by being put to the heating of boilers and other kindred work, but, before this is done, they are made to yield the tar, ammonia, etc., which they contain. It is said this is effected without disturbing the smelting process, and without materially lessening the value of the gases for the purpose to which they have been put.

Dr. Siemens' method of heating by means of his regenerative furnace has now been in use many years, and is employed in many thousands of works. It is constructed so as to utilize the waste heat which, in ordinary furnaces, is allowed to escape up the chimney, and to transfer it to the combustion chamber, by which means a considerable saving in fuel is effected.

Mr. Perkin, in his paper before the society in May, 1879, estimated the value of the coal-tar colors then manufactured in Europe at over £3,000,000 sterling, and this is an industry which only dates from 1856. Although no method for the utilization of wood-tar is likely to prove of as much practical importance as the discoveries in coal-tar, on account of the limited quantity of wood-tar produced, experiments have, of late years, been conducted with this in view, and several new compounds have been produced; but experiments on a large scale are necessary to determine their practical value.

The utilization of blast-furnace slag is not new, but has made great progress. The *Times*, two or three years ago (September 16, 1879), gave a long interesting article on the various uses to which it is now applied.

Scattered throughout the iron-making districts of Great Britain are many million tons of scoria or refuse from the blast furnaces, which is technically known as "slag." This slag goes on accumulating at the rate of nearly eight millions of tons per annum, its bulk being some three times that of the iron from which it has been separated. It forms a heavy incumbrance to ironmasters, demanding the purchase of large tracts of land whereupon to deposit it, the investment being, of course, wholly unremunerative. There are one or two exceptions to this rule, where the slag is tipped into the sea, and serves to form land for the works, and where some of the iron works supply slag for the construction of breakwater and training walls. The quantity thus utilized, however, on the Tees, is but about 600,000 tons per annum, forming only a small proportion of the whole yield of the district.

In early times slag was broken up by hand, and used for road-making, and it so continues to be used, where it can be had without a heavy cost for transport; but there is only a limited demand for this purpose. On the Continent, where stone is scarce, slag plays a prominent part in road-making, as in Silesia and other similarly situated districts. Another direction in which many attempts have been made to utilize slag, both at home and abroad, is to adapt it for constructive purposes, and various schemes have been devised for transforming the highly refractory slag into bricks, sand, and other materials for building.

It is also applied to the manufacture of artificial stone, and moulded into chimney pieces, window-heads, balustrading, and outside ornamental builders' work generally. The stone is composed of two and a half parts of finely pulverized slag, and two and a half parts of ground brick, to one part of Portland cement. The mixture is run into moulds, and sets quickly, the articles being ready for the market in four or five days. Besides bricks and stone articles, the slag is used for making mortar, cement, and concrete. The mortar is a mixture of slag and common lime, the cement being composed of the same materials, with the addition of iron oxides.

Another useful purpose for which it has been successfully utilized is that of glass manufacture. The vitreous character of slag indicates a resemblance to glass in its composition. It does, in fact, contain the principal components of glass, but not in proper proportions, and those in which it is deficient have therefore to be added, with others which are not present. Bottles made of this slag by the Britten Patent Glass Company were shown at the Paris Exhibition in 1878, and received honorable mention.

Another application is to the manufacture of slag-wool. By the action of strong jets of steam, the slag is transformed into a fibrous whitish silicate cotton, which, being metallic, is incombustible, like asbestos. In the construction of new houses with mansard roofs, the space between the interior lath, or paneling, and the exterior covering of zinc, slate, or tin, is filled with this slag-wool, which protects from the rigor of frost in winter and the intense heat in summer. If in winter the taps, and spouts, and water pipes are covered with this slag-wool, it prevents the freezing of the water and the bursting of the pipes and joints. This slag-wool is also used now by gardeners to cover plants, and protect them from the effects of sudden changes of temperature.

In the year following my first paper (1855), Dr. Smith, of Philadelphia, read a paper before the Society, on "The Utilization of the Molten Mineral Products of Smelting Furnaces." This subject is one which has long occupied the attention of the Society, for Mr. T. Twining read a paper on "Pyrolite, or Artificial Lava," in 1848, and a premium of fifty guineas was subsequently offered by the Council for the application to new and useful purposes, but was not claimed. Mr. Charles Wood, of Middlesbrough, gave exhaustive and instructive papers before the Iron and Steel Institute in 1878 and 1877, showing what had been done in the utilization of furnace slag, and also read a paper, in 1880, before this Society on the same subject, which has been published in the *Journal*.*

In view of the general usefulness of slag, when converted into the various articles described, it is to be hoped, in the interests of commerce and progress, that the practice of its utilization may become more and more extended. Doubtless, human progress will show that what is now the veriest waste will, in the course of time, assume a condition of value. Thus will art be made to approximate to nature in that it will know no waste.

There are one or two other mineral substances, formerly neglected, which have of late years been applied to very extensive important uses. One of these is asbestos. This was long considered a mere curiosity for making small fire proof articles. It is the only flexible fibrous mineral substance that is perfectly indestructible by fire or acids, notwithstanding it consists of fibers as fine as the finest linen. Now it is scarcely possible to enumerate all the uses to which it is applied. Among others are, as a roofing material, cement, paint, fire-proof coating for inside of factories, theaters, etc., in danger of ignition, felting for steampipes, boilers, lining for floors, roofs, etc.

A prominent and peculiar feature in the landscape of the coal mining regions is the enormous heaps of black and apparently useless material collected near the outlet of each mine. As the quantity of small waste coal in the United Kingdom has been estimated at 28,000,000 tons per annum, the utilization of this refuse is a matter of national importance in more senses than one. It is now, in many districts, consolidated into blocks, and besides what is used at home, 412,310 tons of this patent manufactured fuel were exported last year.

In several foreign countries, the pitch from coal-tar is combined with coal-dust, and pressed into the form of bricks, and an excellent fuel is thus produced, which, it is said, will generate a greater amount of heat than can be obtained from the same quantity of any other combustible material employed for utility or comfort, while at the same time it can be stored more compactly and in better shape than either wood or coal. Some 40,000,000 tons of valueless coal-dust lying in the vicinity of the coal mines and depots of Pennsylvania have been thus gradually utilized. In some American factories they have found it cheaper and more advantageous to burn only coal-dust or pea-coal. A furnace or grate bar has been specially devised for the purpose of burning this kind of fuel, and there is no doubt, with its increasing uses, but that other convenient devices will be supplied for making it of more practical benefit. The utilization of this waste in the coal regions of the United States is now a decided success. The American Fuel Company, on the Hudson River, works up large quantities of culm (as the coal-dust is technically called) with pitch into blocks, brick-shaped, weighing about 14 pounds each. Anything tending to the utilization of what is now waste is of value, when we consider that the amount of anthracite coal sent to market represents but about four-fifths of the quantity that is actually raised from the earth, the balance being piled up in unsightly heaps.

Many of the subjects which I have incidentally touched upon have been so elaborately dealt with by specialists in papers before the members of this Society that the ground has been taken from under me, and I am but a gatherer and gleaner, summarizing, as it were, the results of their descriptions. Although in the period under review, many of the waste products of manufactures, formerly thrown away, have been made to serve a useful purpose, there is yet room for fresh efforts in this direction, and the reward is certain. The manufacturer who discovers a heretofore unknown use for the waste product of his work necessarily cheapens the cost of the principal article of his production, and thus secures an advantage over competitors. Much, as we have seen, has already been done in this way, but there are many other products which could be made under the direction of that mighty converter, chemistry, to yield substances of use and profit.

Science has taught us how to transmute the waste and refuse materials—elements of pollution—into sources of economy and wealth. The utilization of the sewage of great cities for agricultural ends has virtually been a demonstrated success in Paris and many of our own towns. The same success, by patient experiment, is obtainable in many other waste products, which, in ignorance of their value, we suffer to defile our streets, pollute our rivers, and taint the air we breathe. The purification of the outflow of paper mills, and the utilization of the sludge and other waste products is now carried out.

It would have been impossible, in the limits of this paper, to refer in detail to more than a few of the principal examples of the successful use of refuse. But those enumerated will serve to show to how great an extent civilization is daily adding to the useful products of the world, both by economizing its resources and calling forth new ones by the aid of chemistry.

DISCUSSION.—MULBERRY BARKS.

Mr. Routledge said the paper trade was probably the one which, of all others, utilized waste products more than any other. They utilized cotton waste, flax waste, hemp waste, jute waste, old ropes, canvas rags, and even, as had been said, stable manure, and he had seen very respectable paper made from that material; they also used spent tan. In fact, the paper manufacturer could use any vegetable fiber whatever, sometimes adding a little animal fiber, to give greater strength. Among other materials in connection with the silk industry was mulberry bark; it was customary in all silk-producing countries to grow the mulberry leaves on the young branches of the trees, and when these were stripped they were cut down, and had hitherto been burned. Some time ago he tried to collect them in Italy, but found it cost too much; there was, however, an immense quantity to be obtained in India, and it would, he believed, produce paper equal to what the Japanese made from the paper mulberry. He had been astounded at the statement in the paper of the enormous quantity of maize wasted in the United States, but could readily believe it, for some years ago, having made an excellent quality of printing paper from maize leaves, he took out a patent for it in the States. When he got there, however, he found the cost of collecting the leaves was so great as to render the process practically unworkable. In some places they actually burned the corn to get rid of it. Allusion had been made to the fact that, in 1856, when he introduced esparto, the Society's *Journal* was printed on paper made from it; and he might add that the year before last, a portion of one issue was printed on paper made from bamboo. Asbestos had also been used in paper making, and would be very valuable in some cases, because an uninflammable paper could be made with it. He had some very fibrous asbestos which could be used admirably for what they called a "filler-up." A considerable deal of attention had been given to the utilization of the plantain tree and banana for paper-making, but his experiments had shown that it contained so small an amount of fiber that he did not see how it could pay. The stems of these herbaceous plants contained 80 to 83 per cent. of water, besides a large quantity of mucilaginous and gelatinous matter which must be eliminated, or else fermentation would set up; so that, practically, he did not get much more than 3 to 5 per cent. of fiber.

* Vol. xxviii., p. 578.

He had made excellent paper from Manila hemp in the shape of old rope, and, in fact, the whole of the greenbacks introduced by the Americans after the civil war were made from this substance. He had bought hundreds of tons at £2 to £3 a ton, but the present price was £12 to £13. It was collected by the Americans and exported, because they found that by chemical means they could bleach it, and make magnificent paper material. This hemp was produced by slave labor in the Philippine Islands at a very low cost, and sold here as a semi manufactured fiber, at £25 to £35 a ton for rope-making, and also for making hangings, because it took bright colored dyes. After being thus used it came as a waste product to the paper-maker. Jute waste was also used to a large extent; and to-day, although the importation of esparto grass was very large, probably reaching 200,000 tons, without these waste products consumers would not obtain the cheap paper they did, or the cheap periodicals which were the result of cheap paper. Wood pulp was likely to assume very considerable importance in the paper trade. two or three new processes having recently been introduced, by which pine wood could be converted into cellulose. He had samples of paper made from it, of wonderful strength and tenacity, very much like parchment. This cellulose could be made in two ways, either by boiling the wood with caustic alkali, or by treating it with sulphurous acid; and when the pulp was manufactured you could hardly tell one from the other. He had recently inspected the process in Sweden, and found the results very extraordinary; but it could hardly be called utilizing a waste product, though a large quantity of material was made use of which otherwise would not be of much value.

FIBERS.

Mr. Robottom exhibited a sample of the piassava fiber, which was brought into the London Docks as packing between sugar cases, and also came into Liverpool in the shape of ships' fenders. For some time it was regarded as valueless, but he had introduced it to brush-makers, and it was now largely used for bass brooms. It grew on a tree in Brazil, between Balua and Rio. At present 7,000 tons per annum were used for bass brooms, having practically superseded the old besoms, which were made chiefly by gypsies, both in England and on the Continent. The fiber was produced by a species of palm, about 40 feet high. Another fiber, of which he had a specimen, was of a white color, and came from Mexico. At the time of the Russian war it was feared that Russian hemp would become very dear and scarce, and, seeing this fiber in Liverpool, he went over to Mexico to obtain information respecting it. As far as he could learn, it had been known there from the time of Montezuma, but no one would give him any information about it, and he had to make a journey some 400 miles up the country to find where it came from. He there found hundreds of people engaged in collecting it from a species of aloe, not the yucca, which was a taller tree. They pulled down the leaves with a leathern thong attached to a pole, then put them on a board and scraped them, and two men would in this way get about 40 lb. to 50 lb. a day. The fiber was then packed in bales and sent on mules to Tampico, a journey of eighteen or twenty days, where it was repacked and sent to England. When first introduced here, some people cut it up and sold it for horsehair, but its chief use now was for making small scrubbing-brushes. Another fiber, again, was kittool, which was brought to England from Ceylon, quite by accident. He bought a large quantity at a half-penny a pound, with the idea of selling it to market gardeners, to put under strawberries; but, by accident, some of it was used as a kind of brush for cleaning out an oily saucepan, when it turned a beautiful black, and he then found it could be used as a substitute for bristles. Brush-makers, however, declined to adopt it because of its great durability; they said the brushes would never wear out. He believed he introduced esparto long before Mr. Routledge, viz., in 1849, with the intention of making it into brooms, but it was not strong enough, and he had to give it up, as he had many other things he had tried to introduce. Lard was the first article he ever made money out of, a butcher whom he knew having a quantity sent him by his son in Chicago, which he could not get rid of. That was in 1827, before the oil was extracted from lard. He sold it to soapmakers as a substitute for palm oil, and they liked it very well. He was much indebted to Mr. Simmonds, who was always ready to afford him information.

Dr. W. C. Oudaatje said, in the year 1853 or 1854 a notification was sent to Ceylon that horsehair was very scarce, and just at that time he was making investigations into the products of the island, and one of the substances which came under his notice was the kittool fiber; it was introduced to the notice of the Ceylon Asiatic Society, and a brush which he made of the fiber was sent there also. It was exactly like horsehair, and was used in Ceylon for tying elephants, because of its strength. He could corroborate what had been said as to brushmakers refusing to use it. Since coming to England, he had seen the fiber so beautifully prepared that he could scarcely recognize it, it was so soft and pliant. Mr. Simmonds' contributions to their knowledge of tropical agriculture were so valuable that his name had become a household word in all parts of the world. With reference to the notice of seaweed, he might say that he had that day submitted a specimen of seaweed which had been brought from Ceylon to the Pharmaceutical Society, in the hope that some use might be found for it, as it seemed to possess great gelatinous properties. There were many products which he should be glad to send to the Society of Arts, where he was sure they would receive that attention and examination for which his countrymen would be very grateful.

OLD WIRE RIGGING.

Mr. Liggins said he had noted down one or two waste products which, he thought, might have escaped the attention of Mr. Simmonds. The first was old wire rope. He ascertained, some twenty-five years ago, that this old wire rigging, when too rusty to be trusted, was cut into lengths, and used as ballast in ships going to China, where it was used by the Chinese for making the nails with which they fastened up their tea-chests. With regard to waste coal, he had recently noticed in Paris that a large quantity of what used to be called patent fuel was used in the steamers on the Seine; whether the waste coal came from English collieries, which took coal to France, or from French mines, he could not say.

The next article he would name was Irish peat; about thirty years ago, some friends of his were interested in this question, and, though he could not remember all that was anticipated from the peat, he knew candles were made from that material, for he had some of them. If this waste product, which existed in such large quantities in the south of Ireland, could be utilized in any way, it would be an immense blessing. It was no new thing to make spirit from the molasses of beet-sugar, for rum had been made for generations from molasses, and he had some now which was made in 1851 in Antigua. Again, the manufacture of beet-root sugar itself was not new within twenty-five years; it was the invention of the great Napoleon, during the long war with this country, when the French could not get sugar from their colonial possessions. That it was so successful now on the Continent was in consequence of our fiscal regulations letting it in here free of duty; and the profit on the manufacture being paid by a bounty, it was able to drive the West Indian sugar out of the market, so that the whole trade was going to the United States. It was interesting to know that there was a process for recovering the tin from waste tin-plates; and he remembered being much struck, some years ago, when the Warrior was being built at Millwall, at seeing the wagon-loads of old iron of all kinds going down there. This, he ascertained, was all used to help build the Warrior. He was sorry to find that a large quantity of very valuable iron, in the shape of old horseshoes, was now leaving this country in the shape of ballast, for large ships for China. He grew cotton in the West Indies at the time of the American war, but found it did not pay, and prices offered for the seed on the London market would not pay for sweeping it up. Esparto grass also grew very largely in the West Indies—there were thousands of acres of it—but it did not pay to pick it.

Chevalier Bicker-Caarten said that at the present moment, both in the Netherlands and in Germany, compressed blocks of peat, as well as coal, were used. The mould from under the peat was also used largely for stable purposes. The butterine manufacturers were almost all Dutchmen, and he might say that the greater part of the butter in the shops was butterine. It could be easily detected by melting it in a glass, when the different ingredients would separate into layers. Mr. Simmonds had not alluded to magnesia, which was largely made in France and Germany as a residual product. In France a company had been established to make it from dolomite, and another was being formed in London.

BOTTLE-NOSED WHALE OIL.

By Mr. ALFRED H. ALLEN, F.I.C., F.C.S.

I HAVE recently made a very complete examination of the oil from the bottle-nosed whale, and some of the observations are of general interest. In the first place, I find that the oil has the remarkable chemical constitutions hitherto observed only in the oil from the pure sperm whale, and which shows it to be allied more to the waxes than to the majority of liquid oils. Thus all the ordinary fatty oils of animal and vegetable origin yield, on treatment with an alkali, a "soap," or compound of the alkali used with the fatty acids of the oil, together with the familiar body known as glycerine. The waxes, on the other hand, including spermaceti, yield a soap like the oils and fats, but instead of glycerine they furnish peculiar waxy solids, varying in nature with their origin. Thus the product of the saponification of beeswax is "myricyl alcohol." Chinese wax yields "cerotyl alcohol," while spermaceti furnishes "cetyl alcohol." On similarly saponifying sperm oil, I found it to yield a soap, as usual, but instead of glycerine I obtained a new solid body, which I propose to call "spermyl alcohol," and which I have as yet only incompletely examined. The analysis of sperm oil from different sources shows that the proportion of spermyl alcohol yielded on saponification was remarkably constant, lying, according to present experience, between 38 and 42 per cent. Thus, on saponifying any animal or vegetable oil, there is obtained about 95 per cent. of fatty acids and 10 per cent. of glycerine, but on saponifying sperm oil there results about 60 to 64 per cent. of fatty acids, and 38 to 42 per cent. of "spermyl alcohol"—a white, crystalline, readily-fusible solid.

The bottle-nose oil has yielded me analytical results showing that it is chemically identical with sperm oil. Thus I have obtained from bottle-nose oil 64 per cent. of fatty acids, and 39 to 40 per cent. of spermyl alcohol, numbers which are practically concordant with those yielded by the oil from the true sperm whale. Up to the present time the peculiar composition first noticed by me in the case of sperm oil is not known to be common to any other oil than that from the bottle-nosed whale, so that the latter oil stands alone in its right to be considered as a perfect substitute for true sperm oil. Porpoise oil, and the oils from the various species of whalebone whale, are quite different in chemical nature from the oils of the sperm and bottle-nosed whales. The striking similarity in constitution, amounting, in fact, to chemical identity, between the oils from the sperm and the bottle-nosed whale suggested the probable close relationship of the two animals. On inquiry, I found this suspicion confirmed in the strongest manner. The food of the two animals is very similar, and quite different from that of the Greenland and other whalebone whales; both animals have a back fin, which is not present in whalebone whales; and last, but not least, they both possess large cavities in the head, which are filled with oil. Whether the oils of the narwhal, dugong, and other *cetacea* may not possess characters similar to those of the sperm and bottle-nosed whales is an interesting question which I should like to have the opportunity of practically testing. The oils from the bottle-nosed and sperm whales being identical in chemical nature, and sharply distinguished from all other known oils, it is not surprising that their physical characters should have proved to be very similar. Thus, I find their viscosity, or flowing power, their density, their flashing points, and all other physical characters to be practically identical with each other, and different from those of ordinary oils. These characters sufficiently indicate the bottle-nose oil as a suitable substitute for sperm oil, and I have, in addition, found it as free from tendency to gum or thicken as could possibly be desired.

If further proof be needed of the identity in nature of the oils from the sperm and bottle-nosed whales, it is to be found in the fact that they each deposit spermaceti when cooled to a low temperature. This property of sperm oil is well known, though it is often erroneously supposed to be limited to the oil from the head cavities of the animal, whereas it is in fact true of the oil from all parts of the body. The spermaceti yielded by the bottle-nosed whale appears to be fully equal in quality to that furnished by the true sperm whale, but the quantity obtained is smaller. From the method of its treatment, some of the bottle-nose oil at present in the market has a somewhat strong smell, and possesses an objectionable tendency to become green in contact with copper or brass. These properties render such lots of oil as possess them unsuitable for some of the most valued uses of sperm oil. I have attempted to remedy these defects, and have succeeded in producing a refined oil of a very pale yellowish color, having but little smell, and possessing absolutely no tendency to act on brass or other metals. In other respects it is unchanged. The amount of bottle-nose oil introduced into commerce during the last two years has been considerable, and is rapidly increasing. In some cases it has been sold under the not inappropriate name of Arctic sperm oil, but in other instances it has been mixed with or substituted for real sperm oil, without any acknowledgment of its true nature. From the fact that dissatisfaction has not resulted when the oil has been thus surreptitiously substituted, as well as from the considerations already mentioned, I believe further experience will prove the refined product to be equal to the finest sperm oil, and capable of being used for every purpose to which the latter has hitherto been applied.

HYPNOTISM IN PARIS.

[*From a Correspondent of The Lancet.*]

THE difference between M. Donato's performances and the experiments of Drs. Charcot and Dumontpallier is this: The subjects for experiment by the latter gentlemen were exclusively female patients more or less hysterical, and those exhibited by M. Donato were almost exclusively young men, presumably healthy. This fact, he says, shows the greater magnetic power he possessed over those who experimented on females only; and if he had a subject of the fair sex who accompanied him in all his performances, it was for the sake of convenience, so as to have a subject always at hand. M. Donato's subjects should, according to his own admission, be naturally very sensitive to the magnetic influence, or they should at any rate go through some preparation, or rather training, before they could be considered fit subjects. Would this of itself not imply a certain degree of *complaisance*? As far as I have seen, the young men are a pale, nervous, delicate looking set, and are generally shopmen or clerks; and they are always, or nearly always, the same subjects who go through these demonstrations. I have seen them not only go through all the feats described by M. Charcot with his female subjects, but they seemed to be entirely under the influence of his will—so much so, he had only to will certain things and he was implicitly obeyed without even touching his subjects. For instance, he prevented them, while in the magnetic state, from opening their eyes or their mouths, or from speaking in an audible tone, rising when once on their knees, or from giving a blow with the fist while the arm was placed in such an attitude, notwithstanding the strenuous efforts made by the subjects to put these acts into execution. But what is most wonderful is, the magnetizer could get them to do certain things which are directly opposed to his verbal injunctions, but are strictly in accordance with his will. Thus, in spite of the repeated orders, which he delivers in the most imperative manner, to open their eyes, their mouths, to pronounce words suggested by their magnetizer, they do just the reverse, and remain silent simply because he wills it inwardly.

In some cases, if the subject is magnetized in the midst of a song, he suddenly stops, and resumes it, when he is awakened, just at the phrase or the portion of the word where he had left off. Even the special senses are in the power of the magnetizer, which he can alter at pleasure. For instance, one of the subjects magnetized thought he was enjoying an apple while he was eating a raw potato. The mental faculties of the subject are not less under the control of the magnetizer, for he suspends his memory at will; the subject forgets the most common circumstances and the names of articles of every-day life; indeed, he forgets his own name and even the sex he belongs to. Fortunately, this "lapsus memoriæ" lasts only during the magnetic sleep, from which he is roused by a slight whiff in his face.

What will partisans of cerebral localization say to this, and what will pathologists say when they are informed that phenomena such as those described above, which are the result of certain diseased processes of the brain, all of which are of a complex nature and take time to effect their work, are here produced, cured, and reproduced in a few minutes and at the will and pleasure of a "magnetizer?" I ask whether such phenomena can be *bonâ fide*, even when produced by a man of science? It would seem naive to put such a question, but when I think of the remarks that were made in my hearing at M. Donato's performances, and by men of science, who expressed their belief in the reality of what they had witnessed, and when one takes into consideration the amount of credit obtained for these pseudo-scientific representations through the medium of articles published on the subject in certain periodicals, it seems time that something should be done to expose the fallacy and danger of a doctrine according to which a magnetizer, expert in the art, could command at will the execution of any crime by a subject in the magnetic state. But truth will always prevail, and the impostures, misconstructions, and misrepresentations are, by the more discerning portion of the public, separated from it as the chaff is from the wheat.

This is what has happened to M. Donato's magnetic *séances*, which were found to be all "chaff," mixed up with a semblance of science, as was shown by a certain number of anti-magnetizers, who had got up opposition meetings. Among others, I may notice one convened by M. Carmelli, Professor of Mathematics at a government college, who, finding his pupils so full of M. Donato's experiments on animal magnetism, which diverted them from their studies, determined to prove by practical demonstration that the whole affair, whether it be called animal magnetism or hypnotism, was a monstrous humbug. This the anti-magnetizer had not much difficulty in doing. The meeting was announced beforehand, and, of course, the hall was crowded. At the hour appointed M. Carmelli made his appearance in due form, in evening dress, and accompanied by a Mademoiselle Mariani, his "sujet de demonstration," as M. Donato had his, and who was named Mademoiselle Lucile. M. Carmelli began by assuring his audience that he had never been magnetized in his life, and, consequently, did not posses the mysterious agent called the magnetic fluid. He would, however, undertake to put Mademoiselle Mariani, who also had never been magnetized in her life, through the same processes that M. Donato's subject was in the habit of going through. After a few passes over the forehead and head, a few significant looks, and other manœuvers usually employed on such occasions, Mademoiselle Mariani fell off into a state of catalepsy. She was then placed on a chair, her body being as rigid as a corpse, with her eyes wide open and fixed, from which even the burning of a bundle of phosphorus matches under her nose did not rouse her; there was not a quiver in the muscles of the face, and she looked as white and as lifeless as a marble statue. To show how completely she was under his control, the magnetizer roused her by a few passes, and then, by certain other passes, she fell back again into the cataleptic state. A medical man who was present observed that he had seen all this gone through at the Salpêtrière except the burning of matches, which would be too vulgar a trick for that institution, and he thought that the subject herself, who looked high-

ly hysterical, might have been a patient in that hospital. While in the cataleptic state her eyes were blindfolded, and she went through the usual tricks as cleverly as any somnambulist by profession. After a short rest and a few fresh passes she again fell off into a sleep. The magnetizer then drove a long pin through the fleshy part of the forearm, but she did not flinch, and not a drop of blood was seen oozing from the wound. She was then placed in the horizontal position between two chairs, her head resting on one and her feet on the other, with nothing to support her back. In this position the magnetizer sat, and even stood upright on her, and she lay as inflexible as a board under the man's weight. This brought down a thunder of applause from the assembly, but it having been intimated to M. Carmelli that it was impossible for any person, not under the influence of magnetism, to go through such a feat as Mademoiselle Mariani had just gone through, he simply reminded his audience that it was a feat commonly performed by clowns at circuses and public fairs, who certainly had no pretensions to magnetism; and in order to prove that neither somnambulism nor magnetism had anything to do with it, he proposed rousing his subject from her feigned sleep, and that without any passes or blowing on the head, or even touching her. By the simple word of command, "Mademoiselle, levez vous," she showed signs of gradually coming to by first smiling, and then, stretching out her limbs, she sprang to her feet, and looked none the worse for all she had gone through.

He then explained the trick of passing long needles or pins through the arm without pain, and that it was not necessary to be magnetized to escape suffering, and, suiting the action to the word, he turned up his sleeve and passed a long pin through his own arm. He declared he felt no pain whatever, and invited any one in the assembly to come forward and try the experiment for himself or herself. No one seemed inclined to attempt it until an old gentleman offered his services, and M. Carmelli put him through the same process as he had just gone through himself, the old gentleman also declaring that he felt no pain whatever. This was the acme of Carmelli's success, and before bringing the *séance* to a close he wished to impress upon the assembly that there was no such thing as animal magnetism, that there was certainly an understanding between the magnetizer and magnetized, and that it required some dexterity in performing the tricks and the most scrutinizing attention to detect them. As for the feat of thrusting a long needle or pin through the arm, it was a very common one, and the explanation given as to the painlessness and bloodlessness of the operation was that the parts generally selected were those barely supplied with nerves and blood vessels of any size, as is the case of the upper and fleshy part of the forearm. Besides which, it is a fact well known to surgeons that the muscles are not endowed with great sensibility, and the only pain felt, if at all, would be in the skin, but this would be so slight that, coupled with the dexterity of the operation, the subject would hardly feel any. If the subject be hysterical, this would still more favor the success of the feat, as the skin is generally insensitive in this condition; and this would explain how Mademoiselle Lucile bore the operation so well.

This amateur *seance* was most damaging to M. Donato, who was present, and just at the termination he stood up, and, in a most frantic rage, denounced his adversary's experiments as unscientific and absurd. Whereupon an altercation took place, not only between the principals, but between their respective partisans. This, however, was soon put down, and at the breaking up of the meeting many of the audience left with the firm belief that M. Carmelli was a magnetizer *incognito*, or, at any rate, that he and his coadjutor possessed the fluid without being cognizant of the fact, or that they had some motive for not wishing to own it, as they both, Mademoiselle Mariani in particular, acted their part too well to have merely simulated. Be that as it may, M. Donato's glory from that day grew dim, and Mademoiselle Lucile began to find out that she had not been properly treated in the division of the profits accruing from the *seances*, and as a natural sequence, she quarreled with her *pro tempore* lord and master and denounced him as an impostor. Moreover, at an interview a journalist had with her she fully exposed M. Donato's tricks, and made some very interesting disclosures. Among other things she told her interviewer that at times she was rather refractory, and could not fall asleep. M. Donato then resorted to the expedient of dosing her with opium, which made her feel so drowsy and stupid that he used to pinch her to keep her awake till the proper time arrived. But there were times she was so sleepy from an over-dose of opium that she could not be roused, and it was then that M. Donato had recourse to the young male subjects already referred to, who were regularly trained to go through the processes told off for them. She further avowed that if she had a choice in the matter she would, by a great way, prefer to have the pins thrust into the arm than be pinched as she was, as the latter operation caused her great pain, and her body was covered with boils in consequence. Nothing has been heard of M. Donato since these disclosures were made, and the rage for exhibitions such as he provided in Paris has consequently declined.

PASTEUR ON RABIES.

AT a recent meeting of the Académie de Medecine, M. Bouley communicated, in the name of M. Pasteur, a series of conclusions regarding rabies at which the distinguished investigator has arrived. The first two enunciate the familiar truths that the dumb madness and furious madness, and, in short, all varieties of rabies, are caused by the same virus, and that the symptoms of rabies are extremely variable. It is assumed that the characters of the several cases depend on the points in the nervous system at which the effect of the virus is chiefly localized. In the saliva of rabid animals the virus is associated with several kinds of organisms, and the inoculation of the saliva may cause death in three ways: by means of the special salivary organisms, by excessive suppuration, and by rabies. The medulla oblongata of the human subject, as well as that of animals, after death by rabies, is always virulent, and the virus is also found in all parts of the brain, and it persists even after putrefaction has set in. There are two methods of inoculation by which the period of incubation of rabies may be greatly shortened, and the disease produced not only rapidly but with certainty: one is by the injection of the virus into the blood; the other is by trephining the skull and placing the virus in the arachnoid cavity. Rabies then comes on at the end of six, eight, or ten days. M. Pasteur has met with some cases of the "spontaneous cure" of rabies, but only in cases in which the disease did not develop beyond the initial stage. In such a case, in which the early symptoms passed away, the disease has been known to return at the end of a certain time, as two months, and then to run the ordinary acute fatal course. Mention is also made of the cases of three dogs inoculated in 1881: two quickly died from rabies; the third after manifesting the early symptoms, recovered. The latter animal was inoculated by trephining in 1882 on two separate occasions, but without effect. M. Pasteur asserts that he now possesses four dogs which will not contract rabies, whatever the method of inoculation adopted or the proved virulence of the material employed. These facts he believes to be the first step toward the discovery of a method of the prevention of rabies by its inoculation. He confesses, however, that the end seems to be at present far distant.

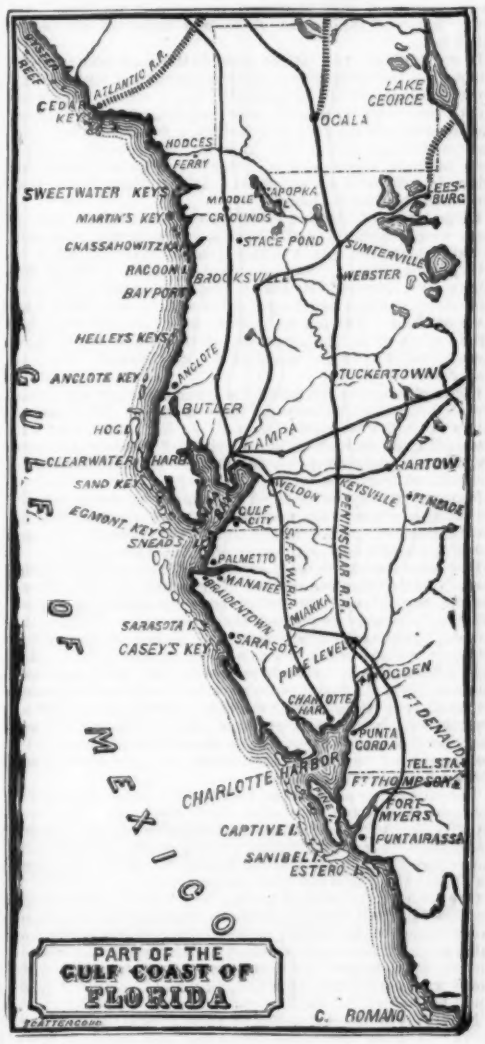
THE GULF COAST OF FLORIDA.

By R. J. LEVIS, M.D.

THE season is at hand when those who, like the birds of summer, take annually their flight southward will be thinking of running away from winter. There are many who seek genial airs and sunlit waters for pleasure only, others to escape from the chilling discomforts of winter; and the great invalid corps, turning its back on cold and death when the leaves fall, makes its pilgrimage to sunny lands.

In the choice of a climate for invalids in general, there are certain health-giving factors which may be summed up as *equability of temperature, purity of atmosphere, and comparative dryness.*

I regard it as essential for most invalids that the temperature shall be such that they may be able to remain for an indefinite time out in the open air without discomfort, and to freely permit it to enter their apartments at all hours of the day and night.



The general prevalence of bright, clear, sunny days, with the rarity of cloudiness and a light rainfall, are essentials of a winter health resort for lung diseases. The physiological, and specially the stimulating and morphological, effects of sunlight on the human system are well recognized; but, owing to the in-door habits of invalids, are too little regarded.

The discomfort and depression produced by the prevalence of violent winds are familiar to most conditions of invalidism, and climates of continuous and moderate air-movements are found to be the most desirable.

An atmosphere of varying electric conditions, with the consequent production of ozone, purifying the air, and keeping it free from septic germs, is favorable.

A dry soil of sand or gravel, which quickly absorbs and filters away the rainfall from its surface, and does not keep the air moist by evaporation, is an essential of a winter health resort for pulmonary affections.

The salubrious atmosphere from extensive pine forests, with their ozone and antiseptic influences, should incline invalids to a choice of such proximity.

Facility for sea bathing, at a tolerable temperature throughout the winter, gives occupation and pleasure, and is an important adjuvant in the treatment of some morbid conditions.

As in incipient and developing pulmonary tuberculosis, and in many other diseases prevalent among the dwellers in cities, it is essential that there shall be a change of habits from a sedentary to an out-door life, the region for a health resort should be one in which there are abundant opportunities for amusement or for agreeable and profitable work in the open air. In a region of country where open air amusements can be varied by riding, hunting, and sailing, and where the scenery is an attractive blending of vistas of forests and stretches of water, the conditions most favorable to an out-door life will be most happily presented.

The poorly-nourished victim of tuberculosis should not be banished to a land where his diet may be impoverished by the lack of fresh meats and vegetables. If he is where he can add to his fare by the products of his recreations of hunting and fishing, then will good digestion be most likely to wait on appetite.

Agreeable society is an essential of happiness and a preventive of depression of spirits in that class of invalids who are obliged to seek winter quarters away from home. Their associations should not be in a crowded caravansary, where the halls echo with the sad sound of coughing, and the corridors seem sepulchral with the hoarse voices of sufferers. Far better is it to find companionship with the woodsman or the fisherman, and be entertained by their woodcraft or simple lore of boats, bays, and streams.

The ideal winter climate for invalids, embracing perfectly all the essentials and suited to the fancy and caprice of sufferers, may not be found, but it can be approximated in its most important requisites.

It is evident that in Europe and in this country mild or warm climates have of recent years grown most in favor as winter health resorts. In our own land, Florida has become the great winter sanitarium for consumptive invalids, for the nervous and debilitated, and for valetudinarians of all degrees, with the prospect of increasing in repute as the merits of some of its most advantageous localities become more generally known. My personal observations of Florida have extended over the regions usually visited by invalids and tourists, and over a domain of wilderness beyond the ready access of travelers. The greater part of the territory of the entire State still remains inaccessible to invalids, and the tide of travel is mostly confined to the great water-course of the St. John's River and its vicinity; but the increased developments of railroads and the coast and interior navigation are about to speedily spread travel over a most attractive sanitary region. That there are portions of Florida much more suited for winter homes than those generally resorted to, it is the object of this article to state.

Florida is a land of many waters. It has a coast line of about twelve hundred miles. Its rivers, lakes, everglades, and lagoons are numberless. It is estimated that from a fourth to a third of the entire State, varying with the season of the year, is covered by water. To its extensive and peculiar water containings and surroundings is due its unique and wonderfully mild and equable climate. Florida is our nether land, which, as Sidney Lanier wrote, by "its peninsular curve whimsically terminates our country in an interrogation point." It geographically and climatically resembles Italy, but its air is more bland and healthful, and its soil has even a greater range of productiveness.

No known land is exempt from the liability of its inhabitants to pulmonary consumption, but in this country statistics of the last two decades show that the disease progressively diminishes from our extreme Northern States southward to Florida. The mortality from consumption, as compared with all other causes of deaths in Florida, is, by the census, but 58 to the 1,000; while in the State of Maine it is 258 to the 1,000; Connecticut, 179; Pennsylvania, 142; and South Carolina, 90.

The low consumption mortality of Florida exists, notwithstanding the number of Northern invalids who seek too late its healthy air, only to end their days and add to the normally very low death rate. The best authority on the subject, Dr. Kenworthy, of Jacksonville, who has given much intelligent attention to climate in the cure of consumption and to sanitary statistics in general, believes that the mortality from consumption among the permanent residents of Florida does not actually exceed thirty deaths to the thousand, from all causes.

Of the extended seaboard of Florida, the Gulf Coast stretches over seven hundred miles. The climate of this coast has, in my opinion, more of the essentials of a good winter resort for invalids than any other of which I know. I make this statement after some personal experience over a large extent of the coast, from much conference with invalids who have happily tested its merits, and from a comparison with the thermometric and hygrometric records of many of the various popular health resorts of the world. The west or Gulf Coast of Florida has a temperature more mild, equable, and dry than that of the corresponding Atlantic border. As compared with that of the much-frequented region of the St. John's River, in the winter season it is free from malarious influences, fogs are unknown, and the opportunities and inducements for an out-door life are far greater. Sidney Lanier, the poet, whose failing days were prolonged by a residence in Florida, says that the air of the Gulf Coast is "milder and drier than on the eastern coast in midwinter; and it is to be greatly hoped that increased facilities for reaching these favorable regions will soon render them practicable to those who now find the journey too trying."

For the agriculturist and the orange-grower, and for the gardener who raises early vegetables for the Northern markets, this coast offers a fertile soil and a climate freer from destructive frosts than any other part of the peninsula. To the capitalist and the investor, for speedy increase in values of lands, the rapid development of railroads—now stretching their competing lines to the fertile hummuck lands and numerous harbors of this coast region—it gives assurance of a flood time of immigration—

> "The first faint wash of waves, where soon
> Shall roll the human sea."

The Gulf Coast has great advantages in its many excellent harbors, and is, in this respect, more favored than the Atlantic border of the peninsula, which, south of the mouth of the St. John's River, has not a single good harbor. The best harbors of the west coast are at Cedar Keys, the Anclote River, Clear Water Harbor, Tampa Bay, Charlotte Harbor, and San Carlos Harbor; but there are innumerable inlets, with moderate depths of water, passing in between the thousands of beautiful islands which border the entire coast line. These islands or keys are lovely fertile tracts, mostly in primitive wilderness, capable of high cultivation, with a delightful climate, and their only disadvantage is the liability to partial overflow from the occasional hurricane tides of late summer or early autumn. Residences on them can be safely located only on eminences above the possible reach of the waters, which may rise six or eight feet above the normal level.

The whole of the Gulf Coast, from Cedar Keys southward, is attractive for health and pleasure seekers, but the southern limit is sharply defined near the end of the peninsula by a region so inflicted with insect annoyances as to render human existence intolerable. How far southward the coast may be in all respects desirable for winter residences, my explorations have not determined; but from Homosassa

down as far as the Ten Thousand Islands, a region included between the 26th and 28th degrees of latitude, the invalid will find a winter climate presenting the essentials, as I have stated them, of *equability of temperature, purity of atmosphere, and comparative dryness.*

At the United States Signal Station at Punta Rassa, about two hundred miles south of Cedar Keys and one hundred north of Cape Sable, the mean temperature for the five cold months for a period of five years is shown in the following table:

	November.	December.	January.	February.	March.	Mean for 5 months.
Punta Rassa.....	69·7	64·8	65·5	65·9	69·8	67·1

Another table shows the maximum and minimum temperatures for the same months in the years 1878 and 1879:

Punta Rassa.	November.	December.	January.	February.	March.	Mean.
Maximum.....	81	76	79	77	81	78·8
Minimum.....	48	38	41	44	55	45·2

Here is shown a winter temperature which, with its well-known equability, renders out-door life agreeable, and dwelling apartments can always be kept open to the free admission of air. The winter temperature is rarely so low as to require even the open wood-fire. The skies, from sunrise over the tops of the pines and palms to the dip of a red sunset into the warm waters of the Gulf, are almost always bright and blue, checkered only by white flying clouds. The balmy breezes blow mildly and almost without ceasing, excepting during an occasional lull of calm at the sunset hour, so that the advantages to health of continuous and moderate air movements prevails.

As to purity of atmosphere, the situation and surroundings are extremely favorable. The breezes blow from either the vast area of waters of the Gulf or from over great forests of pine, palm, and cypress, with their ozonizing influences. It is due to these agencies and to the remarkable dryness that an aseptic condition of the atmosphere exists. I have seen venison, game birds, and other meats remain for many days, or even for weeks, hanging unprotected in the open air, free from taint, and merely become hard and dry without decomposition.

No claim for the sanitary merits of the Gulf Coast of Florida will create so much surprise as that of the comparative dryness of its atmosphere. The natural and popular inference that it has a moist climate must be from a consideration of its vast traverses and surroundings of water, fresh and salt, and not from the trustworthy reports of the Signal Service, or from personal observation. I am not able to give a reasonable explanation of the cause of the remarkable dryness of the atmosphere amid such a realm of waters, but that the climate of this coast is comparatively dry and bracing can be proved by the records of official observation, and attested by the permanent residents of the region. The following table, from official data, of relative humidity of some winter resorts of Europe and America shows particularly well for Punta Rassa, on the Gulf Coast of Florida, during the five cold months:

	Years.	November.	December.	January.	February.	March.	Mean for 5 months.
		per ct.	per ct.	per ct.	per ct.	per ct.	per ct.
Mentone and Cannes.....	3	71·8	74·2	72·0	70·7	73·3	72·4
Atlantic City, N. J.....	5	76·9	79·1	80·6	77·3	76·8	78·1
Breckenridge, Minn.....	5	76·9	83·2	76·8	81·8	79.5	79·6
St. Paul, Minn.	5	70·3	73 5	75·2	70·7	67·1	71·3
Punta Rassa, Fla.....	5	72·7	73·2	74·2	73·7	69 9	72·7
Key West, Fla.	5	77·1	78·7	78·9	77·2	72·2	76·8
Jacksonville, Fla.....	5	71·9	69·3	70·2	68·5	63·9	68·8

Data supplied by the United States Signal Service prove that during the five cold months the relative humidity of Florida, as taken at a number of widely-separated stations of observation, is less than that of what is popularly the "dry winter climate of Minnesota."

For an attractive out-door life in the winter for invalids I know of no region equaling the Gulf Coast of Florida, with its great bays and harbors for sailing, its wonderful fishing and excellent deer-hunting, and the great abundance of feathered game in the forests and on the waters. There is perpetual inducement to spend time in the open air. The sun does not parch, the winds do not chill, and the atmosphere has that indefinable poetic quality called "dreamy." I have felt comfortable in the bracing air when very lightly dressed, and not oppressed when heavily clothed. Sea-bathing is agreeable on the shelly or white sandy beaches all through the winter, and I have found the water warmer on the western than on the eastern coast of the peninsula.

The reason why the Gulf Coast has not been more popularly known as a sanitary resort was the want of convenient access and of accommodations for sojourners, but a happy change is at hand. Coasting steamers now run into all of the more important harbors, as those of Anclote, Tampa, Charlotte, and San Carlos; and railroads are rapidly being constructed to reach the towns all along the coast. The want of convenient residences for invalids is now quite overcome, and comfortable accommodations can be had in every village. The hospitality of the people renders the stay genial and social, and it is a common remark, which I have happily verified, that in Florida wherever you see a house you can find a home, for every home seems open to welcome the stranger.

At a most attractive and salubrious location on the high peninsula between Tampa Bay and the Gulf Coast, on the shore of Lake Butler, a beautiful site for villas is being developed, and a large hotel will be ready this winter for the accommodation of health or pleasure seeking visitors. This locality can be readily reached by the coasting steamers from Cedar Keys to the Anclote River, about seventy-five miles. A railroad, tending in that direction, by way of Waldo, Ocala, and Brookville, has now reached within a short stage ride of the coast near Lake Butler. The land here is much elevated, overlooking the Gulf of Mexico, Lake Butler, and the great Tarpon Spring. The elevation of this region, which is the highest on the coast, and its extensive water surroundings render it most favorable for a winter resort, and indeed for residence during the entire year. A number of persons from the North are about erecting cottages on the shores of Lake Butler, so that abundant accommodations will soon be ready for winter visitors to this favorable locality.

To all who would escape from the severity and dangers of our Northern winters and seek a mild, equable, and comparatively dry climate, free from malarial influences, and where life in the open air is always practicable and agreeable, I commend a journey to the Gulf Coast of Florida.—*The Continent.*

EXPLOSION OF QUARTZ CRYSTALS.

In a paper recently read before the New York Academy of Sciences, Mr. Wm. E. Hidden described the finding by him in North Carolina of a large number of quartz crystals containing cavities with fluid, and their subsequent explosion by freezing. He said:

No mineralogist could have been more careful in preserving the angles and edges of the crystals than was this miner. Not one crystal of the hundreds taken out was in any way injured.

Over four hundred pounds of *choice* quartz crystals were obtained from one pocket, besides the nine emeralds previously spoken of and exhibited before this Academy. Of good, bad, and indifferent, there was found in all nearly half a ton.

It was noticed that all the crystals that had been directly attached to the walls were semi-transparent and without any great development of the prismatic faces; while, implanted upon them, were crystals of great beauty and transparency, varying from citrine-yellow to dark chocolate-brown in color, and for the most part perfect in form. Two-thirds of them were perfectly terminated at both extremities and with considerable prismatic development. It was these latter that contained the fluid-inclusions.

Large plates of rosetted mica were quite common, and on them were implanted small crystals of rutile and of quartz in rare perfection. It is to these smoky crystals, found in this pocket, that I now ask your attention. When the smoky crystals were first found, they were noticed to contain many cavities seemingly filled with a very clear and lustrous fluid. Though no bubbles of air (or gas) were observed to move in these cavities at that time, yet I knew these crystals to be the so-called "water crystals" of mineralogists.

I take pleasure in recording the remarkable size and quantity of the cavities inclosed in these crystals. The longest cavity noticed was nearly *two and one-half inches long* and one-quarter of an inch wide. Cavities of one inch were not uncommon, while those of one-quarter inch and less were, in truth, without number.

Many of the crystals seemed to be made up almost wholly of cavities, whose walls were barely thick enough to keep them separated. Many hundred, plainly visible to the unaided eye, could have been counted in a single crystal.

For some time after these crystals were removed from the pocket, no bubbles were noticed in any of the cavities. Some peculiar condition of the crystal, or of the atmosphere, then existing, probably prevented their formation. Later, the bubbles appeared in great numbers. A few of the crystals were, as water-bearing crystals, very remarkable in size. One weighed nearly twenty-five pounds, had both ends terminated, was of a dark-brown color, and as beautiful as any we have seen from other localities. All the water-bearing crystals were large, none less than two inches in diameter, and many of over three pounds in weight. The cavities were arranged parallel to each other, and to either a rhombohedral or a prismatic face.

The interesting phenomena I observed in these crystals did not occur until some time after their discovery. The best crystals of the "find" were carefully selected and placed where they were considered to be safe—safe at least from molestation. That the weather would interfere, or in any way affect them, did not enter my mind.

One evening in November last (the "find" occurred on October 24), I left these crystals nicely arranged at the mine, except a few of the smaller ones, which I carried to my log-cabin home, thinking the while of what a treat I had in store for mineral collectors and for science. I will frankly confess that I was inordinately proud of my "find"—verily, "pride goeth before destruction."

Now, it is of the *destruction* of these crystals that I must speak. During the night following, the mercury unexpectedly descended below the freezing point. About midnight I was awakened by several sharp reports, like the explosion of gun caps. Over a dozen of these explosions occurred.

In the morning the family were curious as to the cause of the strange explosions heard in the night. Upon the table, where the crystals had been placed the evening before, there remained now only some few fragments of quartz. Pieces of the crystals, large and small, were found even fifteen feet away. In fact, they were completely ruined, and now possessed only the interest of reminding one of what had been. The cold had caused the water in the cavities to freeze, and consequently to expand, and then burst the crystals.

I returned to the mine with the gravest fears for the safety of the finer crystals left there. Judge of my dismay to find not one of them, even the smallest, left intact.

Crystals, that only a few hours before were rare examples of the workings of Nature's laws, were now, by these same mysterious laws, left only as an evidence of her power to do and to undo her grandest achievements. Only crumbled masses of fragments remained to tell the story.

Those with few cavities had burst, scattering large fragments, widely separated; while those containing minute cavities lay as a heap of small fragments frozen together, *in a coherent mass.* This last feature, while being a sad reminder in one respect, is of value to science, since it shows conclusively the abundance of the fluid included; and also, what is of more importance, that this cementing ice was formed either directly from the fluids *in the crystals*, or by influences which they exerted. I do not believe this cementing ice was wholly formed by the freezing of the water contained in the cavities, but was gathered there by the attractive influence of the liquid carbon dioxide upon being so suddenly set free; that this liquid carbon dioxide did, by its natural affinity for moisture, create around it an atmosphere so cold that even the little dampness then existing in the air was congealed upon the crystal fragments.

As the room was a dark one, I had all these masses and larger fragments carried out and placed in the sunlight, for no other reason than to examine them more carefully. I did not anticipate from this any further developments of scientific interest. Again, believe my astonishment, as soon as the rays of the sun touched them, to notice an ebullition commence at once, which, strangely, could be heard a few feet away.

I noticed in some of these masses a very distinct odor of sulphureted hydrogen, which was quite fugitive in some of the pieces, while constant in others. This ebullition was continued for over an hour, growing less as thawing progressed.

While holding a mass of frozen fragments, my hand would become quite wet with the melting ice. I am not in error in stating that a cub. cm. of this fluid could have been easily saved, had the proper means been at hand. It is much to be regretted that none was preserved.

Mr. A. W. Wright gave some valuable data in regard to the composition of fluid-inclusions in quartz. The following is a summary of his results:

He found "that smoky quartz, on heating, entirely lost its color, and that this color was due to the presence of a hydrocarbon of the nature of bitumen."

Aside from this bituminous matter, which is not known to be specially connected with the cavities in the quartz, he obtains the following analysis:

Carbon dioxide.....	98·33
Nitrogen.....	1·67

with traces of sulphureted hydrogen, sulphuric acid, ammonia, fluorine, and probably chlorine.

The results of his investigations showed that the contents of these cavities are chiefly water and carbon dioxide, with a small proportion of nitrogen.

I noticed some curious phenomena in a single fragment, which had by some means escaped destruction by freezing.

This specimen had several small cavities, arranged nearly parallel to each other. At temperatures below 70° a small bubble could be plainly seen to move in each cavity, as the position of the specimen was changed. It was further noticed that the cavities contained two liquids, in one of which the bubble was wholly confined in its movements. This was seen to be the central and more transparent fluid.

If this specimen was slightly heated (the mean heat of the hand was found sufficient), the bubbles would grow gradually less until they disappeared entirely, and the fluids would unite.

On cooling, a critical temperature would be reached, when all the cavities would be filled with numberless minute bubbles, which, rushing together, would in a few seconds form to its full size the bubble originally noticed. I found that this experiment could be repeated indefinitely without any diminution of its interesting phenomena or risk of damage to the specimen.

To Alexander County, North Carolina, and to many of the surrounding counties, we can hereafter look to produce fluid bearing quartz crystals second in interest to those of no other region in the world.

Mr. Hidden's communication was illustrated with a very striking series of inclusion crystals, and of the fragments split off by the frost from the large crystals, as described. The pieces were in the form of large flakes or plates, parallel to the faces of the rhombohedron, and were clouded and filled with elongated or rod-shaped cavities, in immense numbers and of conspicuous size.

ON THE GOLD BEARING ROCKS OF AUSTRALIA.

By I. E. Richter.

In whatever part of the world gold is mined, it is always found in association with certain formations, chiefly in slate schists. In Australia it is also found chiefly in connection with this formation—but more so than in any other part of the world with which the writer is acquainted; it is also found in granite, porphyry, diorite, and serpentine. It is found in the quartz reefs which traverse these rocks; but the deposits which contain waterworn gold deposits that have been derived from the degradation of these formations are of the Permian, Cretaceous, Tertiary, and Quaternary ages. In several localities, notably Ballarat, Cudjegong, and other places, these alluvial deposits have in more recent periods been overwhelmed by flowing lava from adjacent volcanoes (now extinct). This lava proves, on account of its toughness, more obstinate to the progress of the miner than the hardest of granite. At certain localities on the Ballarat field several hundred feet have to be sunk through before the original surface of the alluvial deposits is struck; and these deposits are sometimes 200 feet or more in thickness before the auriferous drift overlying the bed rock is reached. At Cudjegong the river has worn a cañon through this lava rock or basalt like that of the Colorado River (United States). From the banks of the river, adits and tunnels are driven long distances in search of the more remunerative drifts.

Taking a strip of 500 miles wide up the eastern coast of Australia, which is about 1,800 miles north and south, and which is the most mineral bearing and mountainous portion of this island continent, about one-fourth is of gold bearing formation. It is significant that but little silver has been discovered in this tract, though tin and copper are comparatively abundant.

Quartz reefs are worked and numerous in the sedimentary rocks of the Upper Silurian, Devonian, and Carboniferous ages. In whatever formation gold bearing reefs are found, the majority have a north and south strike, the rest showing to all points of the compass. Many miners of long experience claim that those of north and south strike yield the most gold, but the evidence to verify this belief is insufficient. These reefs are from a few inches to twelve feet wide, a few only being over four feet wide. They are often vertical, but sometimes with an inclination, and usually run in a straight line with the strata of the formation, over hill and dale, in many cases for several miles, independent of the configuration of the hills or valleys that they traverse. The deepest payable quartz mining is worked at about 1,400 feet. In many abandoned shafts of a depth of 1,000 or 1,200 feet the records seem to show that the deeper the mine, the poorer the stone. A few now working show the reverse, while many are of a more patchy character in their yields, wherefrom no deductions could be made in favor of either theory. On the whole, it may be taken that the limit to the depth that gold bearing quartz may be worked is only challenged by the greater cost of working the mine at the greater depths.

For several years after the first discovery of the metal, gold mining was carried on in the alluvial drifts only. At

Bendigo, at this time, many of the roads and streets were macadamized with the hardest stone obtainable in the vicinity This was quartz. As the continuous action of the wagon wheels ground this stone slowly to powder, the wind and rain carried away the lighter particles, leaving the gold, which could be seen glittering in the sunshine, after a rainy day. This singular occurrence seems to have given the first impulse to quartz mining. Many amusing stories are told of women and children patroling the road at daybreak after rain to gather up the gold dust, which the wet had made the more visible, the earliest bird obtaining the most of the good things.

At Ballarat, Castlemaine, and Bendigo, a great deal of gold was obtained from surface workings, occurring generally on the lower slopes or spurs that led from the higher ridges. At these workings the gold was found dispersed in even quantities through the angular gravel, pebbles, hard soil, and roots of tuft grass that composed eight or nine inches of the surface. Underlying this was from one to two feet of hard stiff red clay, containing no gold. This, in turn, overlaid the slate rock.

All gold in its native state is more or less impure, but where it is found with the least impurity, as at Ballarat, it is worthy of remark that very few of the precious stones are found associated with it, while at Kiandra, where the gold is less pure, platinum, satin stone, ruby, emerald, sapphire, are found with it. At Bingera, gold is found in the alluvial drifts with the diamond and other precious stones. At Canoona, gold was obtained with gypsum pebbles and ironstone gravel on serpentine formation, perhaps the only instance of the kind known, while the gold itself was coated with a thin film of iron, so that small nuggets could not be told from the ironstone grit, except by the weight.

At the Granite diggings, and also at Araluen, the gold in the alluvium has, in the opinion of many geologists, not only been derived from the degradation of the quartz reefs that traverse the granite rock, but also by the segregation of the particles of the granite itself.

All gold which has as yet been raised in Australia has always been more or less alloyed with silver, sometimes also with traces of copper, iron, and osmo-iridium.

At Rockley, gold occurs in partly vitrified talcose schists. At Blayney, a large breccia lode is worked, in which the gold is finely distributed. It is the opinion that the metal here has been deposited in solution, but in what manner can scarcely be conjectured. At Barmedman, gold is found in the quartz veins with pyrites and galena as well as in the cleavage and cross fissures of the adjoining slates. Near Glen Innes, it is found in conjunction with ores of bismuth. At Tallawang, and other places, it is distributed in thick beds of pebble conglomerate forming the base of coal measures, but resting on Silurian schists traversed by quartz reefs, wherefrom the gold may originally have come. At some recent openings on the Albert fields, a small measure of gold has been found in marine conglomerates, evidently of the Cretaceous age, resting on Silurian and granite formations.

Of the Tertiary deposits, gold is chiefly obtained in the Middle and Upper Pliocene alluvia. These alluvia must be of fresh water origin, consisting, as they do, of ancient river drift, pebble, grit and clays, the remains of mineral bearing formations that have been disintegrated by elemental agencies during the erosion of the valleys. From these drifts have been exhumed trunks, branches, and leaves of trees, bones of birds and extinct marsupials, and fresh water mussel shells. In this connection it is worthy of note—according to Baron Von Mueller, whose researches are indefatigable, that the Upper Pliocene is the oldest formation in which, as yet, the eucalyptus has been discovered. From this it would appear that this genus, which includes the principal forest trees of Australia, is, speaking from a geological point of view, of comparatively recent introduction or origin.

At Mount Brown, which is situated more toward the center of Australia, where the climate is arid, the gold is found in shallow drifts of clay and gravel. For the want of water, these drifts are crushed into powder, then put through a winnowing or dry blowing machine to separate the particles. This is a tedious process.

At several localities where the writer spent some time, the quartz veins traverse along the line of junction of serpentine and hornblendic porphyry. The stuff which occurs in these veins along with the quartz contains calcite, asbestos, serpentine, and mispickel. Through the latter the gold is sometimes visible.

In the quartz reefs throughout Australia the gold found in the quartz is always associated with one or more sulphurets, iron pyrites, copper pyrites, galena, mispickel, blende. Calcite is sometimes met with, also barytes; and at Hill End, muscovite. At the latter place the reefs traverse clay schists and metamorphosed conglomerates. In these conglomerates are impressions of encrinites. How the reefs originated in the conglomerates is one of the several mysteries in geology that remain unexplained. At a quartz reef near Braidwood, cobalt, iron pyrites, copper pyrites, and galena occur. At Greufell, quartz reefs are worked in porphyry. At Gulgong, and Temora, in diorite. At Gundagai, Lucknow, and Canoona, in serpentine.

The quantity of gold raised in Australia, since its discovery in 1851, is about 2,200 tons, valued at about 1,400,000,000 dollars. The greater part of this amount has been obtained from the alluvial deposits.

The richest deposits of gold have always been found in the slate schists, granite, and diorite formation. The porphyry and serpentine formations have never yielded much, and the same may be said of sedimentary rocks of the Carboniferous age.

PLANTING IN WASTE PLACES.

By BERNHARD E. FERNOW, of Slatington, Pa.

Most of the methods recommended and described in American papers for planting forests presuppose that the ground to be planted is arable, or at least workable with the spade. This may be all right for the Prairie States; yet there are probably on every farm in the mountainous regions more waste places than anywhere else, that will never pay to get the stones out—that won't grow any grass of value, and that defy all cultivation. There are others which are too wet, and on account of their nature drainage for agricultural use is impossible or unprofitable; others again, which on their dry shifting sand will not bear any crop.

These are the very places to which, in time, the forest in every well settled country will be more or less confined, the better portions being needed for farming purposes; and fortunately enough, not only can such places be made to bear forests, but, being so used, they are improved, and often, after some time, gain in value, even for agricultural crops.

To find out cheap methods for covering such places with a tree growth is therefore a task not to be neglected.

With this object in view, I give the following description of a very valuable instrument, to be used in places where the spade is not easily applied, or where it is an object to quickly cover a large area. It is especially applicable for one and two year old plants (in most cases the best age for planting), and is most extensively used in Germany, for the inforestation of the large heaths, in the sandy plains, and in mountain lands. Millions of young pines are planted every year in this way.

This instrument consists of two parts: a shoe made of iron, with one rounded and one flat side, tapering toward the end, in shape like a half cone, so that two of these shoes placed together, with the flat sides, would represent a perfect cone, or nearly so; in the center (somewhat nearer the flat side) of the base is a threaded hole to receive the handle, which consists of a five-eighths inch rod three and one-half feet long, with a squarely set wood haft. The shoe may be made eight inches long and three and one-half inch at the base, and to make it somewhat lighter it may be cast with a a square oblong hole half way through the back.

The *modus operandi* is to thrust this iron dibble into the ground where the plant is to stand, somewhat open up the hole thus made, by moving the dibble back and forth; withdraw, put the plant into the hole to the straight side, thrust the dibble again into the ground one to one and a half inches back of the first hole, somewhat slantingly toward the bottom of this, press forward to fasten the plant in its stand; then by a few irregular thrusts close the last made hole and proceed to the next place.

The original instrument had a short, rounded handle, and the whole operation was done by one man, who could dispose of 1,200 to 1,700 plants, according to locality.

Where the planting is done on a large scale, the work progresses most expeditiously if an active boy, or still better, as my experience goes, a woman, serve two planters with the plants. The planters manipulate the dibble, while the boy with the plants, in a mixture of loam and water (to keep the roots not only moist, but also heavy for better dropping into the plant hole), holds the plant in the hole, first serving the one and then the other. With this force, if accustomed to the work, 5,000 plants may be disposed of per day, or as for such planting of yearlings, at least 7,000 plants should be set out per acre. The planting will cost from $4.50 to $5.50 per acre.—*Journal of Forestry.*

In the village of Pedur, in India, grows a marvelous palm. Some children plucked its fruit at five o'clock one afternoon, and went early the next morning to gather more, but they found the branches now far above their heads. They ran to their parents with the story that a date tree which they saw on the previous day lying upon the ground was now standing. Observation disclosed that the tree had been changing its position every morning and evening. The tree is eleven feet high, not including the leaves and stems.

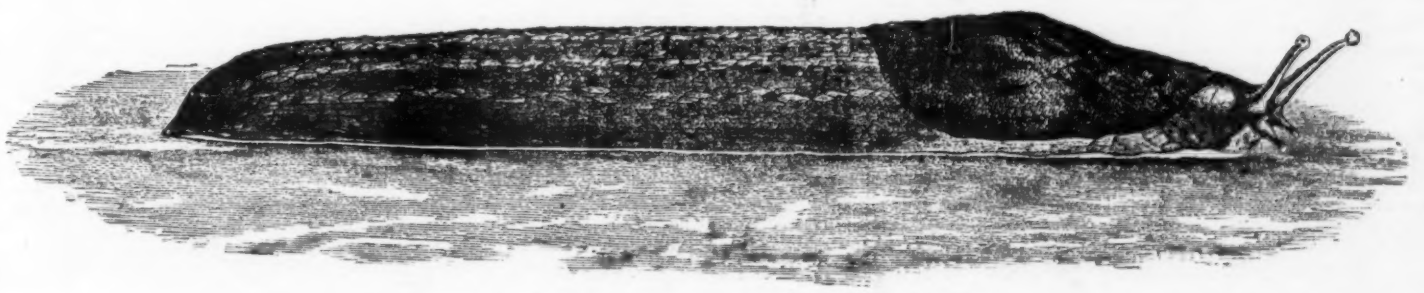
SLUGS AND SNAILS.

In spite of the crazy maunderings of sentimental anti-vivisectionists, gardeners will probably continue to regard slugs and snails as their mortal foes, and to wage war to the death upon them accordingly "to the end of the chapter." We have been watching a tender nursling for a week, when, lo! in a single night it is gone. We seek the marauder, and martial law is at once enforced. To the true gardener, however, every living thing in his domain, from the overshadowing elms with their colony of garrulous rooks to the tiniest mite that lives in the damp moss and decaying wood of the fern house, is, or should be, of interest. Each may be potent either for good or evil to his plant charges. If, then, our gardener asks a man of science the simple query, "What is a snail?" he may be met with the reply that it belongs to the class Gastropoda of the sub-kingdom Mollusca, and be referred for further information to a specialist who is styled a "malacologist." Probably these three sesquipedalian words will have been enough for him, and he will return to his place a sadder, but a no whit wiser man. Without flinging unnecessary technicalities about, we propose to discuss, first, briefly what a snail is, and, secondly, what are the common slugs and snails that appear in our gardens.

Zoologists divide all animals into some six or seven sub-kingdoms or major groups, based, as are all their classifications, upon structure. The lowest animals are almost without structure, mere particles of animated jelly, generally microscopic in size, and known as the "first animals" or Protozoa. Above these are the jelly fishes, polypes, and sea anemones, which consist mainly of stomach, and are hence termed by another Greek word Cœlentera. Higher still is the group with long soft bodies made up of rings, with mere bristles in lieu of legs, or with star-shaped bodies and horny and spiny shells; the star-fish, sea-urchins, and worms, both of land and of water, that are all classed together under the comprehensive Latin name Vermes, or in plain English, worms. If our own vanity makes us rank at the head of the animal world those beings which possess a backbone like ourselves, the fishes, frogs, reptiles, birds, and beasts, or vertebrata, justice compels us to admit that in mental development we are closely rivaled by that other sub kingdom with tough skins and jointed limbs that includes crabs, lobsters, scorpions, spiders, centipedes, and insects, the Arthropoda, or jointed footed ones, a group related by its lowest forms to the worms, but including the butterfly, the bee, and the ant. There yet remains a sub-kingdom including animals with soft bodies, often, but not always inclosed in hard shells, their bodies not divided into rings or segments like worms, leeches, or centipedes, nor furnished with bristle-like feet—a group including the oyster, the scallop, the mussel, the limpet, the cattle-fish, the octopus, the beautiful pearly nautilus, and last, but not least, the slugs and snails. This sub-kingdom is the

MOLLUSCA

—the soft animals. Besides minor sub-divisions it embraces four chief classes. The first of these rejoices in the appellation of Lamellibranchiata, the plate-gilled, and any one who will take a river mussel and cut it deftly open will see the reason why in the large, brown, two-layered gills that lie within. The members of this class have two shells, which are generally alike, but are each unsymmetrical. Here belong the oysters, cockles, scallops, and mussels, animals having no very distinct head. Next in rank are the Pteropoda, or wing-footed ones, minute animals with glassy shells and two spreading wing-like appendages that float on the surface of the open ocean and furnish food for the whale. Then follow the Gastropoda, of which more anon, the highest class being the Cephalopoda, large animals with a circle of eight, ten, or more arms, furnished with suckers placed around the mouth—the squids, cuttles, devil-fish, and nautilus of to-day, and the ammonites and belemnites of past geological epochs. In these three higher classes there is a distinct head, and a remarkable organ sometimes called a tongue, or lingual ribbon, but more correctly the odontophore, as it is studded



THE CELLAR SLUG (LIMAX CINEREUS).

with rows of hundreds of flint teeth; which when drawn, as they are, by a sort of pulley, backward and forward over a cushion-like body, work sad havoc in the plant world. While all mollusks are characterized by their soft bodies, enveloped in a muscular skin or mantle, which usually secretes a shell composed mainly of carbonate of lime, the gastropods have this mantle in a sac-like form with an opening in front from which the head and so-called foot are projected, and the shell, though sometimes altogether absent, is never composed of more than one piece or valve. It is true some snails have a little shelly lid on the end of their fleshy foot which acts like an undergraduate's "sported oak" when they are indoors and would be "not at home," but this is not secreted by the mantle, and does not count as shell.

The gastropods take their name (meaning belly-footed) from the broad, flattened muscle of the lower part of the body, by the successive expansions and contractions of which the animal crawls, as may be well seen in the wave-like motion of a snail on a piece of glass. This is called the foot. Slow and awkward as are its movements, a snail is by no means deficient in organization. It has a distinct stomach and a liver, so that a gardener may sometimes piously invoke upon its head an attack of dyspepsia. It has a heart with veins and arteries, though its blood is colorless; a nervous system with special organs for seeing, hearing, and probably for smelling; and a breathing apparatus, adapted in some for aquatic, in others for terrestrial life. The nervous system consists chiefly of a nerve ring round the throat, send

ing off branches to the tentacles and eyes; to the mouth, and to the other parts of the body. The eyes in our slugs and snails are two in number, as in ourselves, and though of such simple structure that it is doubtful if they can do more than tell light from darkness, they have the advantage of us in carrying them on the ends of two flexible and extremely sensitive stalks or tentacles, which they can draw outside in like the finger of a glove. Near the base of each tentacle is an ear, a round vesicle containing a minute vibrating lump of calcareous matter called an otolith. Though not yet detected by anatomy, when we watch snails attracted by strong smelling fungi, and marine gastropods by animal matter, we cannot doubt that organs of smell also exist. Snails certainly soon express their disapproval of salt or lime water, and the copious greenish saliva they pour from the salivary glands of the mouth would make us accredit them with a sense of taste if every gardener had not already been too well convinced of their discriminative palates.

The food is obtained by the action of the odontophore, which Professor Huxley thus describes: "It consists essentially of a cartilaginous strap which bears a long series of transversely disposed teeth. The ends of the strap are connected with muscles attached to the upper and lower surface of the hinder extremities of the cartilaginous cushions, and these muscles, by their alternate contractions, cause the toothed strap to work backward and forward over the end of the pulley formed by its anterior end. The strap consequently acts after the fashion of a chain saw (or rather of a rasp) upon any substance to which it is applied, and the resulting wear and tear of its anterior teeth are made good by the incessant development of new teeth in the secreting sac in which the hinder end of the strap is lodged." These teeth are amber colored, translucent, and insoluble in acid, being composed of silex or flint. The ribbon on which they are may be as long as the animal itself. The Roman snail has 21,000 teeth, and the great slug 26,800 in 180 rows of 160 each! Their breathing apparatus is of great importance in the study of gastropods, for it is taken as the basis of their classification. As "there be land rats and water rats," so there be land snails and water snails, sea slugs and land slugs, and the vast majority of the 22,000 species of known gastropods are marine, and breathe by gills. About 6,500 inhabit the land or fresh water, and breathe by means of a lung or air-chamber, formed by a little fold in the mantle, which has an opening to the air on the right side of the animal. These form the order Pulmonifera, or lung bearers, and to this order belong all the slugs and snails with which we are concerned. The shells of these animals are closely related to their breathing organs, being also formed from the mantle. In the land snails the shell originates as calcareous granules within the substance of the mantle, and all living shells are covered with an insensitive epidermis or scarf-skin. When the animal dies, this skin becomes bleached, and the shell loses those colors which often serve during life to protect it from its enemies by their resemblance to surrounding objects—leaves, stones, or soil. Some few gastropods have the shell evenly developed in the adult, as in the embryo, as a conical cap or tube; as, for example, the limpet and the tooth shell (Dentalium). Some slugs have no shell whatever, but more often it is rudimentary, and covered by a thick layer of the mantle. The vast majority of gastropods, however, are developed in a one-sided manner, that gives the familiar spiral form to their shells. The shells of land snails have not to withstand the dashing of breakers on the rocks, nor have the animals always access to such an unfailing supply of carbonate of lime as sea water. They are, therefore, thinner and less pearly, and contain more animal matter than those of marine forms. For a similar reason, they do not require to produce eggs by the hundred thousand, but only by the score. Slugs bury their eggs in the ground, each egg being separate and inclosed in a shell. They are hatched in summer or autumn, hibernate during the winter, and reach their full size during the next year. Though in confinement land snails live for as many as six or eight years, in their natural state they generally die during their second winter. A specimen of *Helix lactea* from the south of Europe proved itself to be alive after two years in a cabinet by producing twenty young ones, while one of the *Helix desertorum* in the British Museum, brought from Egypt, revived after four years' quiescence.

The Pulmonifera are subdivided into two sections—the Operculata, which have a calcareous operculum or lid on the end of the foot to close the shell, a group of some 500 species, and the Inoperculata, twelve times as numerous, which have no such lid. In many of these latter, however, a layer of hardened parchment-like mucus, sometimes strengthened by carbonate of lime, is formed over the mouth of the shell during hibernation. This is called an epiphragm, and is always perforated opposite the respiratory orifice. Mr. Darwin found that the Roman snail (*Helix pomatia*), which has such a epiphragm, lived after twenty days' immersion in sea water, a fact that partly explains the world-wide distribution of some genera of land shells.

The chief British species among the Operculata is a pretty little spiral shell known as *Cyclostoma elegans*. It is spirally striated, and takes its name from its round mouth. The animal has the eyes at the base of the tentacles, and an elongated proboscis. It occurs on chalky soils, as at Boxhill and Mickleham, Dartford and Berkhamsted, in the London district, and may occasionally stray into gardens in such localities. By far the greater number, however, of our hundred British Pulmonifera (of which we are concerned, not with the fresh water species, but only with the land ones) belong to the two Inoperculate families—the Limacidæ, or slugs, and the Helicidæ, or snails. In the former the shell is small and usually internal, and the body is not distinct from the foot; in the latter the body is distinct, and is generally capable of being entirely withdrawn within the spiral external shell.—*The Garden.*

THE NASIQUE.

(*Dryunus nasutus.*)

IN the luxuriant forests of hot countries, in the East Indies as well as in tropical America, the traveler often beholds suspended from the midst of the foliage, and like vines gently swayed by the wind, strange serpents whose color, which is of the most beautiful green, harmonizes wonderfully with that of the surrounding vegetation. These animals can scarcely be perceived, so like in hue are they to the plants around which they are twined.

Among these serpents there is a certain number that zoologists know under the name of Oxycephalians. In these the body is exceedingly elongated and very thin, so that, amid the vegetation, they really resemble hanging vines. Their head is long and narrow, especially in front; and the snout runs out to a conical point which often exceeds the lower jaw. Their tail, which is greatly elongated, is whip-shaped. Although sometimes reaching a length of three feet and beyond, these serpents are in some cases only the size of the finger. The Oxycephalians are provided with venomous teeth at the posterior part of the upper jaw, and, although inoffensive to man and the larger animals, are to be feared by the smaller mammiferæ and young birds, which constitute their usual food.

These serpents all live in trees, and it is there that they pass entire days in watching for their prey. Some have the snout ending in a hard point, and among these are the *Oxybelæ* of Guiana, Brazil, Martinique, and Gabon, and the *Tragops* of the East Indies; while in others the snout is prolonged into a blunt point, sometimes notched, as in the *Langaha* of Madagascar, or simple, as in the *Nasique*.

This last named snake, which has lived for a long time at the Reptile Menagerie of the Paris Museum of Natural History, is a native of Java, Ceylon, the Celebes, Sumatra, and the Indian Peninsula. It was designated by Daubenton by the name of *nez retroussé*, by Lacépède as *Nasique*, and is known by modern naturalists under the systematic name of *Dryunus nasutus*.

As in all the other species that compose the family, the body is greatly elongated, in the form of a whip. The head is wider than the neck, oblong, and slightly depressed; the snout is prolonged into an angular point widely exceeding the lower jaw; and the pupil has the form of a longitudinal slit. The back appears as if carinate. The whole body is covered with smooth, greatly elongated lozenge-shaped scales.

When the animal is in repose, it appears of a brilliant green relieved by a few yellowish lines. The belly is paler than the rest of the body. When the snake is excited, either through anger, or at the sight of its prey, it swells up, and its scales on distending allow the color of the skin to be seen. At such a moment there is observed a series of black and yellow stripes detaching themselves very agreeably from a green ground.

THE NASIQUE.

In the majority of cases, the serpent remains motionless, closely coiled around a branch; and the forward part of its body, standing out straight and lightly agitated, seems the continuation of the branch upon which the animal is fixed. The reptile is on the watch, however; and, when it sees its prey, it uncoils slowly, allows itself to hang down, and, like a branch put in motion by the breeze, it swings near its victim and swiftly seizes it. The mouth is very widely cleft, so that the serpent is capable of seizing prey of relatively large size.—*La Nature.*

ROSE GLOIRE DE DIJON AS A WINTER BLOOMER.

IT has often been said, and can hardly be too often repeated, that, take this fine rose for all and all, we can hardly meet its like again. But of all its many merits, that of blooming right up to or right through the winter is among the most valuable. It is at once among the hardiest and most perpetual blooming of all roses. The first quality has hardly been so often adverted to or fully recognized as it deserves. As a tea rose it stands alone in vigor and hardiness of constitution. Amid the many and wholesale slaughter of the innocents, so painful to the rosarian, few have ever had to mourn a Gloire de Dijon among the slain; and it not only withstands the cold, but blooms on in spite of it. Though a frost of ten or more degrees binds its swelling buds in iron fetters to-day, a genial change has only to invite them to open on the morrow, and forthwith they expand as if nothing particular had happened in the interval. This capacity of being frozen with impunity is one of the most valuable characteristics of this fine rose. The majority of roses once severely frozen are crippled for the season; the shoots are injured, the blooms robbed of their color or fragrance, or both. But those of the Gloire de Dijon retain both color and perfume, and seem little or none the worse. Probably part of this immunity from injury from cold arises from mechanical causes. The form and substance of the buds of Gloire de Dijon are well fitted to exclude moisture and resist frost. They are so full of rose leaves as to afford no room for water, which falls off them almost as freely as off a duck's back. The form as well as the substance of the buds also assists in shedding off the moisture. Doubtless, too, the extreme doubleness and consequent compactness of the flowers arrest to some extent the penetrating power of the frost. Be all that as it may, the fact is patent that the Gloire de Dijon withstands cold better, perhaps, than any other rose in cultivation.

On south or west walls there are few days from May to January on which half or fully opened buds of this rose may not be gathered. It also does well on east and north walls, and on every possible mixture of all the cardinal points. In fact, where room can be found on walls, house, outhouse, stable, or fence, Gloire de Dijon roses should be planted in every available aspect. This will do very much indeed to create and sustain a continuous succession of bloom throughout the year. This rose should also be planted in mixed borders and shrubberies in beds and sheltered nooks and corners in all directions. It is also admirable for clothing arches, arbors, or summer houses, running up poles, forming pyramids, rough groups or bushes, or making hedges. A hedge of Gloire de Dijon alone, or with a few plants of Gloire des Rosomanes among it here and there for the sake of contrast, is admirable.

No tea and very few other roses form finer or more effective standards than Gloire de Dijon; with skillful manipulation they can also be moulded into very effective weeping roses, a form but seldom seen nowadays. For such purposes only a few strong shoots, say from five to nine, should be allowed to grow, and bent down over a hoop or some other contrivance. These will then break and flower throughout a great portion of their length, and will form specimens of great richness and beauty—most unlike, in their flowing grace, the usual run of stiff and formal standard roses.—*D. T. Fish, in The Garden.*

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